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Bulletin of the Lloyd Library of Botany, Pharmacy and ...

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FOURTH REPORT ON

The Lloyd Mycological Museum,

[illegible] 1931
[illegible]

CINCINNATI, OHIO.

Last: Jan. 1918

FOR THE YEAR 1898.

We are gratified to report the addition of 720 named specimens during the year. Most of these specimens have been received through the kindness of friends and correspondents, and we are pleased to acknowledge in detail our indebtedness.

Prof. Chas. Peck, of Albany, N. Y., has collected about fifty specimens in alcohol. Prof. Peck has been an active student of our native agarics for upward of thirty years, and has contributed more than all others together, to our knowledge of these plants. We all recognize him as our authority on American agarics and to a set of authentic named specimens by him, we attach the greatest value. We appreciate the kindness all the more, as we feel that Prof. Peck himself does not place much value on alcoholic specimens.

Prof. N. Patouillard, of Paris, has favored us with critical opinions of specimens we have sent him and has also sent many specimens for our museum. We had the pleasure of meeting him personally last winter and feel much gratified in getting him interested in our work.

Rev. G. Bresadola, of Tirol, likewise has been very kind in giving us critical opinions of plants sent to him, and has sent us a large number of European types. A full set of the Fomes of Europe is on the way now, but has not been received in time for this report.

Our correspondence with these two eminent Mycologists of Europe, and the interchange of specimens has demonstrated that a large number of plants common to both countries are known by different names in this country and in Europe, and hence authentic named specimens of European plants are of the utmost importance in acquiring on accurate knowledge of our own flora.

Rev. A. B. Langlois, of St. Martinsville, La., has continued his collections as evidenced by the numerous references to his name in the list. Many of the plants of a Southern type of his collection are unique in the museum.

HARVARD UNIVERSITY HERBARIUM.

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Prof. E. A. Burt, of Middlebury, Vt., sent a number of fleshy plants in alcohol. As in previous years, his specimens are collected with the greatest care, and no one sends nicer alcoholic specimens than he.

T. J. Fitzpatrick, Lamoni, Iowa., has favored us with a number of dried specimens.

A beautiful lot, mostly of Fomes, was received from C. V. Piper, Pullman, Washington. The shipment also contained a most interesting Hydnum, analagous to Fomes, which was described in Myc. Notes.

Prof. J. B. Ellis, Newfield, N. J., has named a number of specimens, but owing to the illness of his wife, I have not felt disposed to impose on him as much as usual the last few months.

But a few specimens were received from Prof. A. P. Morgan, Preston, O., owing to the fact that his collection has been pretty thoroughly robbed in previous years.

My friend Dr. Wm. Herbst, Trexlertown, Pa., has continued his collections, both dried and in alcohol.

E. Bartholomew, Rockport, Kansas, collected a number in alcohol, including several type specimens named from his collection, and of the greatest value in a museum of this kind.

Prof. A. J. McClatchie, sent us a few alcoholic specimens from Pasadena, Cal. Since his removal to Phoenix, Arizona, we have received nothing from him, but we have faith that he has not forgotten us.

Mr. Chas. Crossland, favored us with a fine package of English specimens last winter, including a nice lot of Bovista nigrescens, a species we do not seem to have in this country.

Prof. J. Dearness, London, Ontario, has made two shipments of dried specimens, adding a large number to the collection.

We have received some *rare* plants from the following gentlemen.

E. B. Sterling, Trenton, N. J., Cyclomyces Greenii, Lentodium squamulosum and others.

Capt. Chas. McIlvain, Colebrook, Pa., a beautiful specimen of Cyclomyces Greenii, and others.

Hollis Webster, Cambridge, Mass. Cyclomyces Greenii, Naucoria Christinæ, Lepiota rachodes, Mitremyces lutescens and others.

F. J. Braendle, Washington, D. C., Stropharia bilamella, Mitremyces lutescens and others.

Correspondents and friends in general, have brought and sent to me fungi they have found, in several instances that proves of much interest.

I am indebted to the following for kindnesses in this line:

G. W. Hubbard, Nashville, Tenn.
Grant Wyrick, Chicago, Ills.
Prof. Wm. Miller, Cincinnati.
G. B. Fessenden, Boston, Mass.
Allie Kemme, Cincinnati.
Geo. Ell, Cincinnati.
Prof. W. H. Aiken, College Hill, O.
David James, Cincinnati.
B. O. Longyear, Agricultural College, Mich.
Rev. C. H. Demetric, Emma, Mo.
R. L. Hawkins, Cincinnati, O.
Tom Bell, Cincinnati, O.
H. J, Koch, Cincinnati, O.
Prof. W. C. Bloyer, Cincinnati, O.
J. H. Hart, Trinidad.
H. Kræmer, Philadelphia.
A. D. Selby, Wooster, O.
Prof. Thos. Norton, Cincinnati, O.
S. D. Rouse, Covington, Ky.
A. S. Hitchcock, Manhattan, Kans.
Hugo Bilgram, Philadelphia.
Miss Hays, Ithaca, N. Y.
E. M. Holmes, London, Eng.
Wm. Knox, Cleveland, O.

Specimens listed in the collection by the name of the country as France, Alabama, were acquired by purchase. I am indebted to Prof. Patouillard for examining the French specimens and revising their determinations.

The season in this neighborhood was favorable for fungus growth, especially in June and September. We have collected quite a number from this locality, which we had not previously met. Specimens of my collection are indicated in the list by the letter L. and an additional letter showing the location of the collection. L. C. relates to specimens collected in the neighborhood of Cincinnati: L. K. to specimens collected at Crittenden, Ky., about twenty-five miles south of Cincinnati.

During July a visit was made to Dr. Herbst, at Trexlertown, Pa., and Prof. Ellis, at Newfield, N. J., but owing to the excessive dry weather that prevailed in those sections at that time, but few specimens were secured.

The names under which the plants are listed, are as labeled when received, or as determined when collected. In a few instances subsequent study or advice has changed the name, but the corrections are not indicated in the list which was made from the museum record, as the plants were entered when received.

January, 1899.

C. G. LLOYD.

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CATALOGUE OF SPECIMENS ADDED DURING 1898.

AMANITA, *vaginata,* (*var fulva*) Peck. *farinosa,* Peck, *spreta,* G. W. Hubbard. *muscaria* (*var formosa,*) Peck, *Frostiana,* Peck, *solitaria,* Wyrich, *candida,* Alabama, *prariicola,* Bartholomew.

LEPIOTA, *procera,* L C, (*form rubescens,*) L C, *granulata,* Burt, *cepæstipes.* Burt, *metulæspora,* L K, *cristata,* Burt, Peck, Patouillard, *subremota,* Wm. Miller 2, L C, *clypeolaria,* L K, *farinosa,* Fitzpatrick, Wm. Miller, L C, *pusillomyces,* L C, *fuscosquameus,* L C, *erinaceus,* L C, *alluviina,* L K, *meleagris,* L C, *cœrulescens,* L C 2, *lilacea,* Burt, *rachodes,* Patouillard, Fessenden, Webster, *mastoidea* Patouillard, *naucinus* Patouillard.

ARMILLARIA, *melleus,* Peck, *nardosmia,* Braendle.

TRICHOLOMA, *personata,* Braendle, *sejunctum,* L C, *dryophila,* McClatchie, *Peckii,* Peck, *Georgii* Patouillard, *fumescens,* Braendle.

CLITOCYBE, *monodelphus,* Langlois, L C, (*abortive form,*) Langlois, *multiceps,* Braendle, *laccata,* (*var pallidifolia,*) Peck, *revoluta,* Burt, *sinopica,* Peck, *ditopus,* Herbst, *clavipes,* Burt.

COLLYBIA, *velutipes,* Kemme, Bartholomew, *radicata,* (*yellow form,*) L C, *stipitarius,* L K, *butyraceus,* Burt, *tuberosa,* Peck, *confluens,* Patouillard, *acervatus,* Peck, L C, *macilenta,* L K, *myriadophylla,* L C, *maculata,* L C, *conigena,* Burt, *spinulifera,* Burt, *cirrata,* Patouillard.

MYCENA, *corticola,* Burt, Aiken, L C, *luteo-alba,* L C, *luteopallens,* L C, (*white form,*) L C, *Adonis,* L C, *epipterygia,* Peck, *pura,* Burt, *immaculata,* L C, *hæmatopoda,* Peck.

OMPHALIA, *campanella,* Burt, Peck.

PLEUROTUS, *griseus,* L C, *mastrucatus,* Langlois, L C, *ostreatus,* France, McClatchie, Alabama, Herbst, *porrigens,* Burt, *dryinus,* David James, *reticulatus,* L K.

HYGROPHORUS, *eburneus,* Braendle, L C, *Ravenelii,* L C, *chrysodon,* Burt, *Laurii,* L C.

LACTARIUS, *piperatus.* Peck, *volemus,* Peck, *distans,* Peck, *subdulcis,* Peck, *insulsis,* Fitzpatrick, *affinis,* Burt, *glyciosmus,* Burt, *subvellerius,* Alabama, *trivialis,* L C. *serifluus,* L C 2, *cinereus,* L C, *varius,* Peck, *aquifluus,* Peck, *luteolus,* Webster, *rufus,* Longyear.

RUSSULA. *crustosa,* Peck 2, *virescens,* Peck, *integra,* Fitzpatrick, *variata,* Peck, *consobrina,* (*var sordida,*) Peck.

CANTHARELLUS, *cibarius,* Peck, *cinnabarinus,* Peck, *floccosus,* Peck, *aurantiacus,* L K, *tubæformis,* Crossland.

NYCTALIS, *asterospora,* Herbst.

MARASMIUS, *oreades,* France, *epiphyllus,* L K, *plancus,* Bartholomew, *ramealis,* L K, *fagineus,* L K, *peronatus,* Patouillard, *epodius,* Bresadola.

LENTINUS, *lepideus,* Aiken, *Lecomtei,* Fitzpatrick, *ursinus,* L C, *ventricosus,* Alabama.

LENTODIUM. *squamulosum,* Sterling 2.

PANUS, *dealbatus,* Demetric.

LENZITES, *betulina,* France, Crossland, Fitzpatrick, *vialis,* Dearness 2, Fitzpatrick, *sepiaria,* Dearness, Patouillard, Piper, *corrugata,* Dearness 2, *flaccida,* France, *Klotzschii,* Alabama 2, *tricolor,* Bartholomew.

VOLVARIA, *volvacea,* R L, Hawkins, *striatula,* Bartholomew, *Loveiana,* Dearness.

PLUTEUS, *cervinus,* (*var alba,*) Burt, *granularis,* L C, *admirabilis,* L C, *umbonatus,* L C.

ENTOLOMA, *sericellus,* L C 3.

CLITOPILUS, *abortivus,* (*abortive,*) Herbst.

NOLANEA, *picea,* Burt.

ECCILIA, *nigricans,* McClatchie.

CLAUDOPUS, *nidulans,* Alabama 2, *variabilis,* Crossland.

PHOLIOTA. *adiposus,* Dearness, L K, *unicolor,* L C 2, *luteifolia,* Langlois 2, *præcox,* McClatchie, *marginata,* Burt, *comosa,* Bartholomew 2.

PLUTEOLUS, *coprophilus*, L K.

INOCYBE, *geophylla*, Burt, Braendle, *rimosa*, L K, L C, *fastigiata*, Burt.

HEBELOMA, *Colvini*, Bartholomew, *pallidomarginata*, Tom Bell, L C 2, *versipelle*, Herbst, *crustuliniformis*, Burt, *excedens*, L C.

FLAMMULA, *spumosa*, L C, 2, *rigida*, Herbst, *Highlandensis*, Peck.

NAUCORIA, *pediades*, L C, *Christinæ*, Webster.

GALERA, *lateritia*, Peck, Burt, *antipoda*, Burt.

CREPIDOTUS, *fulvotomentosus*, Peck, *crocophyllus*, L C, *dorsalis*, Burt, *malachius*, L C, *aureus*, Aiken, *tiliophilus*, L K, *sepiarius*, Longyear, L C.

CORTINARIUS, *cinnamomeus*, (*var. semisanguineus*,) Peck, *turmalis*, L C, *subferrugineus*, Burt, *autumnalis*, Burt.

GOMPHIDIUS, *vinicolor*, Herbst 2.

PAXILLUS, *atratomentosus*, Peck, *cinnabarinus*, L K, *panuoides*, Peck.

PSALLIOTA, *campestris*, McClatchie, *silvicola*, Dearness, *cretaceus*, L C, L K, *subrufescens*, McClatchie, *arvensis*, Koch.

STROPHARIA, *cæsifolia*, Bartholomew, *semiglobata*, Herbst, L C, *merdaria*, L C. *bilamella*, Braendle.

HYPHOLOMA, *sublateritium*, Burt, (*var squamosum*,) Burt, *perplexum*, Burt, *velutinum*, Burt, *incertum*, Bartholomew, *cutifractum*, Bartholomew, *pyrotrichum*, L C, *nitidipes*, L C, *saccharinophilum*, L C, *reticulatum*, L C, *lachrymabundum*, Burt, *hymenocephalum*, Peck.

PSILOCYBE, *Foenisecii*, Burt, *uda*, Peck, *cernua*, Burt.

PSATHYRA, *semivestida*, L C, *gyroflexa*, Burt.

PANAEOLUS, *solidipes*, L C, *retirugis*, L C 3, *fimicola*, L C 2, *campanulata*, Peck, Burt, *papilionaceus*, Bert, L C, *epimyces*. Dearness.

PSATHYRELLA, *tenera*, L K.

COPRINUS, *comatus*, Burt, *atramentarius*, McClatchie, Burt, *pulchrifolius*, L C, L K 2, *ebulbosus*, Bartholomew 2, *tomentosus*, Bloyer 2, *Lloydii*, Herbst, *fuscescens*, L C.

MONTAGNITES, *Candollei*, Patouillard.

BOLBITIUS, *sordidus*, L C.

BOLETUS, *Americanus*, Peck, *auriporus*, Peck, *brevipes*, Alabama, *castaneus*, Peck, *felleus*, Fitzpatrick, *granulatus*, Alabama, *indecisus* L K, *illudens*, Peck, *luridus*, L K, *parasiticus*, Patouillard, *piperitus*, Peck, *gracilis*, Peck, *chrysenteron*, Peck, *punctipes*, Dearness, *Clintonianus*, Burt, *subvelutipes*, Peck, *albus*, Peck. *tridentinus*, Bresadola.

STROBILOMYCES, *strobilaceus*, Dearness, Fitzpatrick.

BOLETINUS, *porosus*, Fitzpatrick, *pictus*, Dearness.

FISTULINA, *hepatica*, Patouillard.

POLYPORUS, *retipes*, Alabama, *Earlei*, Alabama 2, *brumalis*, France, Herbst, *biennis*, Bresadola, (*gasteroporus form*,) Bresadola, *rufescens*, Demetric, *Forquignoni*, Patouillard, *cryptopus*, Bartholomew, *picipes*, Dearness, France, Peck, *elegans*, Dearness, *intybaceus*, Dearness, Fitzpatrick, *Talpæ*, J. H. Hart, *Berkeleyi*, H. Kraemer, *distortus*, Fitzpatrick, *sulphureus*, Dearness, Crossland, *subluteus*, Dearness, *lacteus*, Herbst, *stipticus*, Patouillard, *delectans*, (*Myriodoporus form*,) L C, *croceus*, Patouillard, *isidioides*, Alabama, *gilvus*, Dearness 2, Fitzpatrick, *fumosus*, France 2, *adustus*, Dearness, France, Herbst, Peck, Langlois, *fumosus*, Dearness, *dichrous*, Dearness, L K, *cuticulis*. Dearness, L C, *hispidus*, France, *obtusus*, Demetric, *pubescens*, France, (*var Grayii*,) Alabama, *resinosus*, Fitzpatrick, Alabama, Piper, *fuliginosus*, Bresadola, *betulinus*, Patouillard, France, Crossland 2, *officinalis*, Piper, *salignus*, Herbst, *Auberianus*, Langlois.

FOMES, *lucidus*, France, Langlois 3, Alabama, Patouillard, Shelby, Norton, J. H. Hart, (*Myriadoporus, form*,) Langlois, *pinicolor*, Dearness, Piper 5, *ulmarius*, Bresadola, Patouillard, *fraxinophilus*. Fitzpatrick, *conchatus*, France, *applanatus*, France 2, Piper, France, Crossland, Bartholomew, (*var vegetum*,) Patouillard, *fomentarius*, Dearness, *Evarhartii*, Herbst, *nigricans*, France, *ignarius*, Dearness 2, France, Piper 3, *marmoratus*, Hitchcock, (*myriadoporus form*,) Patouillard. *rimosus*, L C, *fulvus*, Alabama, France, *Euonymi*, France, Patouillard 2, *salicinus*, France, Piper, *reniformis*, Piper, *hemileucus*, Langlois, *pectinatus*, Langlois, *rubriporus*, Patouillard, *connatus*, Herbst, Morgan, *roseus*, Piper, *obliquus*, Langlois, *3*.

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POLYSTICTUS, *Montagnei*, Dearness, *cinnomomeus*, Bresadola, *subsericeus*, Dearness, *perennis*, France, *pictus*, Patouillard, France, *sanguineus*, J. H. Hart, *biformis*, Fitzpatrick, Langlois 2, *Feei*, Langlois, *pergameus*, Bresadola, Patouillard, *pseudopergameus*, Dearness, *cinnabarinus*, Dearness, Fitzpatrick, *radiatus*, France 2. *Braunii*, Patouillard, *versicolor*, France 2, Fitzpatrick 2, Herbst, Piper, *hirsutus*, Patouillard, Braendle, (*white form*,) Piper, *zonatus*, France, (*form lutescens*,) Bresadola, *abietinus*, Patouillard 2, Alabama, France, Bresadola, *tabacinus*, Langlois.

PORIA, *vulgaris*, France, *mollusca*, France, *medulla-panis*, Langlois, Crossland, Bresadola, *vitreus*, Langlois, *obducens*, Herbst, *illinita*, Langlois, *vincta*. Herbst 2, *salmonicolor*, L C 2, *cinerea*, L C, *subfumosa*, Langlois, *rufo-gilva*, Langlois, *fulvo-marginata*, Langlois, *vaporaria*, Alabama, *ambigua*, L C 2, *megalopora*, Bresadola 2, L C, *sinuosa*, Dearness, *homaema*, Dearness, *aurantio-tingens*, Langlois, *ferruginosus*, Dearness.

TRAMETES, *Peckii*, Fitzpatrick, *sepium*, Herbst, *serpens*, France, *Bulliardi*, France, Patouillard, *trabea*, Bresadola, *lutescens*, (*var Trogii*,) Bresadola.

DAEDALEA, *confragosa*, Fitzpatrick, Herbst, Bartholomew, *unicolor*, Herbst 2, *quercina*, France.

CYCLOMYCES, *Greenii*, McIlvain, Sterling, Webster.

FAVOLUS, *europaeus*, Bresadola, Patouillard, *Canadensis*, Fitzpatrick.

MERULIUS, *rubellus*, Dearness, *tremellosus*, France 2, Fitzpatrick, *corium*, France, Herbst 2, L C, *aureus*, Langlois.

PTYCHOGASTER, *rubescens*, Bresadola, *albus*, Bresadola, *rufo-albus*, Bresadola.

SOLENIA, *ochracea*, Herbst.

HYDNUM, *repandum*. Peck, *zonatum*, Fitzpatrick, *adustum*, Dearness, *coralloides*, Dearness, Fitzpatrick, S. D. Rouse, *erinaceus*, Fitzpatrick, *septentrionale*, Fitzpatrick, *flabbelliformis*, Alabama, *udum*, Herbst 3, *subtile*, Langlois, *Stevensoni*, Langlois, *Caput-ursi*, Burt, *chrysocomum*, Alabama 2, L C, *albidum*, Peck, *auriscalpium*, Patouillard, *pallidum*, L K, *pudorinum*, L C, *tinctorium*, Piper.

IRPEX, *cinnamomeus*, Langlois, *sinuosus*, Herbst 2, L K 2, *crassus*, Fitzpatrick, *paradoxa*, France, *discolor*, L C.

RADULUM, *orbiculare*, France, Herbst, L C 2.

SISTOTREMA, *confluens*, Alabama.

PHLEBIA, *orbicularis*, Langlois, *radiata*, France.

GRANDINIA, *granulosa*, France, L K, *ocellata*, (*var lutea*,) Langlois, (*var lilacina*,) Langlois, *lutea*, Langlois 3, *hydnoides*, Langlois.

ODONTIA, *fimbriata*, France, *glauca*, Langlois.

THELEPHORA, *Schweinitzii*, Fitzpatrick, *caryophyllum*, Dearness, *laciniata*, Crossland, *intybacea*, Dearness, *pedicellata*, Langlois, Alabama, *palmata*, Fitzpatrick, *Micheneri*, Dearness, *sebacea*, L C, *vialis*, Herbst 3, *griseo-zonata*, Alabama, *retiformis*, Alabama.

STEREUM, *spadiceum*, Dearness, *purpureum*, France, Herbst, Bresadola, *versicolor*, Dearness, *lamellatum*, Hitchcock, *hirsutum*, France, Crossland, *radians*, Alabama 2, *cristulatum*, France, *rugosum*, France, *insignitum*, Patouillard, *fusciatum*, Alabama, *vorticosum*, L C.

HYMENOCHAETE, *tabacina*, France, Herbst, *corrugata*, France, Herbst, L K, *fulvella*, Langlois, *rubiginosa*, France, *rhabarbarina*, L K.

CORTICIUM, *incarnatum*, Herbst, *calceum*. Langlois, *laeve*, France, Herbst 2, *scutellare*, Langlois, *portentosum*, (*var crystallophorum*,) Langlois, *sanguineum*, Crossland, *Marchandii*, France, *caeruleum*, France, Alabama, *fuscum*, France, *echinosporum*, Langlois, *pactolinum*, Langlois, *albido-carneum*, Langlois.

PENIOPHORA, *flavido-alba*, Langlois 2, *quercina*, France 2, *carnea*, (*var microdon*,) Langlois, *vermicosa*, Langlois, *lilacina*, L C.

CONIOPHORA, *Ellisii*, Langlois.

CYPHELLA, *fulva*, Herbst.

CLAVARIA, *cristata*, Burt, *pyxidata*, Fitzpatrick, *fumosa*, Burt, *flava*, Peck, *vermicularis*, Aiken, *aurantio-cinnabarinus*, Herbst.

CALOCEA, *cornea*, Herbst.

EXIDIA, *glandulosa*, Burt, Herbst.

ULOCOLLA, *foliacea*, Burt.

HIRNEOLA, *auriculea–Judae*, L C.

GUEPINIA, *spathularia*, Langlois, *elegans*, Morgan.

AURICULARIA, *mesenterica*, France, Patouillard.

DACRYOMYCES, *corticioides*, Langlois.

PHALLUS, *duplicata*, (*Egg*,) L C, *Ravenellii*, Fitzpatrick, L C 2, *Novæ-hollandae*, L. N. Fowler.

NIDULARIA, *pulvinata*, Langlois.

CRUCIBULUM, *vulgare*, Crossland, Patouillard.

LYCOPERDON, *pulcherrimum*, Fitzpatrick, *gemmatum*, Crossland, *perlatum*, Crossland, Patouillard 2, Piper, *separans*, Peck, *pyriforme*, Piper, Bilgram, *subincarnatum*, Peck, *pusillum*, Piper, *saccatum*, Crossland.

GEASTER, *limbatus*, Hays, *saccatus*, Bilgram, *striatus*, Fitzpatrick, *hygrometricus*, Patouillard 2, *fornicatus*, (*var multifidus*,) Bartholomew, *Bryantii*, Holmes, *fornicatus*, France, *pectinatus*, Bresadola, *granulosa*, Bartholomew.

MITREMYCES, *lutescens*, Braendle, McIlvain, Webster.

TYLOSTOMA, *campestris*, Dearness, *fimbriatum*, Alabama, *granulosum*, Patouillard, Bresadola.

CALVATIA, *saccata*, Patouillard, *pachyderma*, Piper.

QUELETIA, *mirabilis*, Patouillard.

SECOTIUM, *acuminatum*, Alabama, Demetric, *Warneii*, Piper.

BOVISTA, *pila*, Fitzpatrick, *amophila*, Piper, *nigrescens*, Crossland 2, Bresadola, *obovata*, Aiken.

SCLERODERMA, *vulgare*, Dearness, France, *verrucosum*, Dearness, Crossland, *Geaster*, Alabama, *flavida*, Alabama.

POLYSACCUM, *pisocarpium*, France.

MORCHELLA, *conica*, L C, *semilibera*, L C, *esculenta*, Crossland, Patouillard, Bartholomew.

HELVELLA, *crispa*, Dearness, *infula*, Burt, *lacunosa*, Crossland.

MITRULA, *vitellina*, (*var irregularis*,) Dearness.

GEOGLOSSUM, *hirsutum*, Crossland.

LEOTIA, *chlorocephala*. McIlvain.

BULGARIA, *inquinans*, Dearness, Holmes.

PEZIZA. (*Acetabula*,) *cinnamomeo-lutescens*, L K, (*Otidea*,) *onotica*, Fitzpatrick, (*Cochleatae*,) *aurantiacus*, Wm. Knox, *cochleata*, Tom Bell 2, *vesiculosa*, Tom Bell 2, (*Discina*,) *repanda*, L C, (*Pustularia*,) *radula*, L C, (*Lachnea*,) *coccinea*, Patouillard.

ASCOBOLUS, *atro-fuscus*, L C.

ONYZENA, *equina*, Dearness.

HOLWAYA, *Tiliacea*, Dearness.

TUBER, *brumale*, Patouillard.

ELAPHOMYCES, *variegatus*, Crossland.

TERFEZIA, *aphroditis*, Patouillard, *Boudieri*, Patouillard, (*var arabica*,) Patouillard.

TIRMANIA, *ovalispora*, Patouillard.

PHÆANGIUM, *Lefeborei*, Patouillard.

MISCELLANEOUS.

Cordyceps ophioglossum, Dearness, *Peridermium cerebrum*, Alabama, *Peronosporia infestans*, Dearness. *Badhamia*, *macrocarpa*, Crossland, *Tubulina*, *cylindrica*, Crossland, *Myxosporium intidum*, Herbst, *Hypomyces lactiflua*, Dearness, *Hypocrea citrina*, Patouillard, *Xylaria polymorpha*, Crossland, Fitzpatrick.

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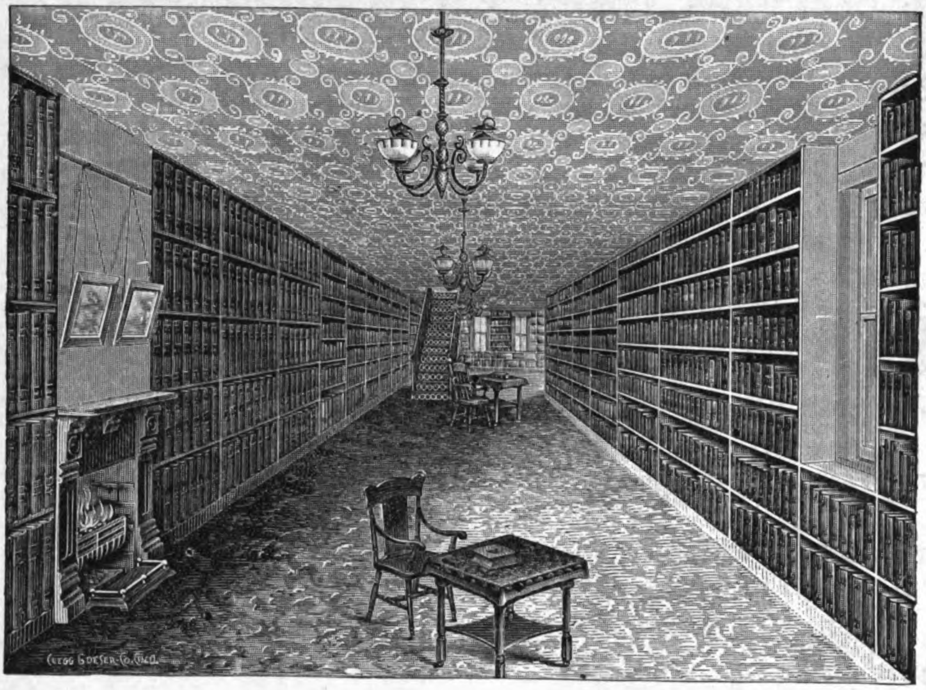
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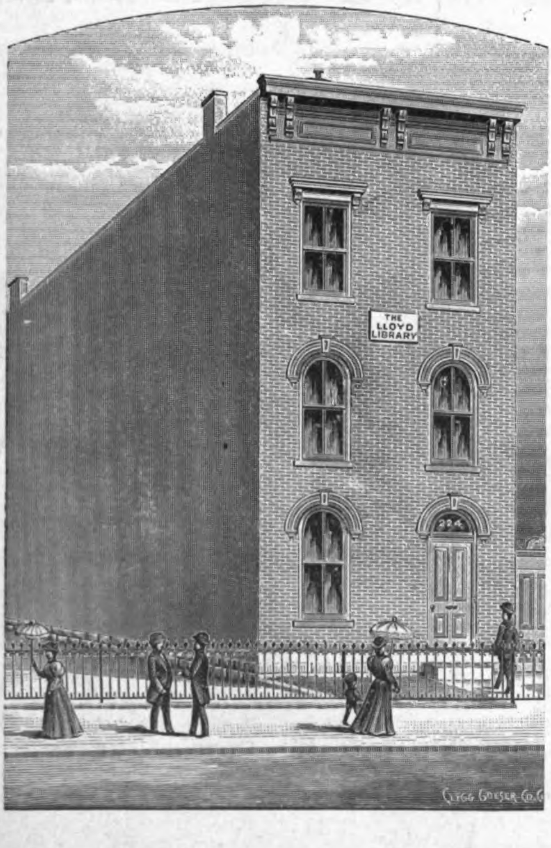

The Lloyd Museum and Library.

The Library on the 1st of January, 1898, contained in the botanical section (C. G. Lloyd,) 4619 volumes (by count) and about 2000 pamphlets (estimated,) and in the Pharmaceutical section (J. U. Lloyd,) 3715 volumes (by count) and 1000 pamphlets (estimated.)

Our library and museum will never be sold. We shall complete it as far as possible during our life-time, and it will be donated in its entirety at our death, to the educational institution where it will do the most good.

J. U. & C. G. LLOYD.

BULLETIN

OF THE

LLOYD LIBRARY

OF

BOTANY, PHARMACY *and* MATERIA MEDICA

CINCINNATI, OHIO

VOLUME I **QUARTO**

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BULLETIN No. 1. 1900. REPRODUCTION SERIES, No. 1

BULLETIN
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of
BOTANY, PHARMACY AND MATERIA MEDICA

J. U. & C. G. LLOYD
CINCINNATI, OHIO

REPRODUCTION SERIES, No. 1

COLLECTIONS FOR AN ESSAY TOWARDS A MATERIA MEDICA OF THE UNITED STATES

By Benjamin Smith Barton
Philadelphia, 1798 & 1804

WITH BIOGRAPHY AND PORTRAIT

BULLETIN OF THE LLOYD LIBRARY

For some time we have been considering the advisability of utilizing a number of the rare works on the shelves of the Lloyd Library of Pharmacy and Botany, in a manner that will conserve the interests of scientific societies and libraries. Our plan is to publish in as nearly facsimile as possible, the rarest of the early works connected with Pharmacy, Materia Medica, and Botany, and to supply them by exchange to journals and societies connected with these branches of science, and also at the nominal price of $1.00 per issue to persons who desire them for their private libraries. But while this will be a feature of each Bulletin, we shall also aim to contribute more or less original matter, such as biographies and portraits, as well as other subjects of interest.

The contemplated new departure for the Lloyd Library is now accomplished by instituting the series of Bulletins, of which this is the initial number.

The present Bulletin carries a complete reproduction of the "Collections for a Materia Medica of the United States," by Benjamin S. Barton, which we aim to make as nearly in facsimile as possible—punctuation, size of original page, spelling of words, and style of type. This work, being the first English attempt at a materia medica of American plants, is an invaluable historical reference book, and should be in every library connected with pharmacy and botany. We have also prepared a biography of the author as an introduction, and present his portrait as a frontispiece.

Our second Bulletin will reproduce, in full, the first work on medicine published west of the Alleghany mountains, *Peter Smith's Dispensatory*, of which but one copy is known to exist. The third will reproduce the Materia Medica Americana of Schoepf, which was the first botanical work connected with American medicinal plants.

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BENJAMIN SMITH BARTON, M. D.

BENJAMIN SMITH BARTON

Was the son of an Episcopal clergyman, Rev. Thomas Barton, and born in the village of Lancaster, Pennsylvania, February 10, 1766. His mother, who was the sister of the well-known astronomer, David Rittenhouse, died when he attained the age of eight years, and his father died when he was but fourteen, so that at a very early date young Barton was debarred parental care and training. His father had planned to take a trip to Europe, but died before sailing. A few years previous to leaving Lancaster, he placed his younger children, the subject of this sketch among them, with a friend in the country near the village. The love of nature, so marked in after years, was the result of his village and country life, and it is probable that this bent was furthered both by inheritance and by instruction from his father, who inclined to the study of Natural History. This is made evident from the fact that the father was a member of the American Philosophical Society, and corresponded with Linnæus on botanical subjects, as well as that he possessed, according to his son, a "fine collection of North American minerals, which was made by my father near forty years ago, at a time when he paid more attention to this part of natural history than, so far as I know, any other person in the colonies."

Young Barton developed a love for drawing at an early age, and maintained the accomplishment in after life, even becoming skilled at etching. It is said that his love of drawing and much of his instruction in the art was acquired from Major André, who was a prisoner in Lancaster.* He was very exacting in this direction, insisting that the illustrations for his books be precise and true to nature, forbidding any attempt at display by the artist for "artistic effect."

In the spring of 1780 young Barton and one of his brothers were placed in an academy at York, Pa., where he gave his attention for two years to classical studies. At the expiration of this time his elder brother, who lived in Philadelphia, took him to his home, and, during this period he attended the College of Philadelphia, which directed him towards medicine. In 1884, when eighteen years of age, he selected as a preceptor the well-known physician, Dr. William Shippen, and made a start in his life work.

Not content with medical lore derived from books, all of which at that date came from Europe, he gave his attention to the investigation of American productions. With this object in view he accompanied (1785) the commission of which his uncle, Mr. Rittenhouse, was a member, in its work of running the western boundary of Pennsylvania. Here he made the acquaintance of the Indians, and began his researches in the direction of the simples employed in their medication, as well as a study of their customs and history, a work he carried on during his subsequent life, and which led finally to the publication of the "Collections for an Essay towards a Materia Medica of the United States," which work appears in full in this Bulletin of the Lloyd Library.

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* History of the Medical Department of the University of Pennsylvania.

In further considering the life of B. S. Barton, we find that in 1786 he went to Europe as a medical student, and, excepting a few months spent in London, remained for two years in Edinburgh. While here he issued (1787) a little pamphlet titled "Observations on Some Parts of Natural History: to which is Prefixed an Account of some Considerable Vestiges of an Ancient Date, which have been Discovered in Different Parts of North America." This, his first attempt at public print, was not very creditable, being marred by some crudities and amateurish theories that very soon afterward became patent to himself. While here he became a member of The Royal Medical Society at Edinburgh, and, presenting thereto a paper on *Hyoscyamus niger*, won the Harveian prize. But, for personal reasons, he left Edinburgh before graduating, taking his degree at the celebrated German University at Göttingen in the fall of 1789. While in London he was kindly treated by both Dr. Hunter and Dr. Lettsom, who recognized his talents and scientific attainments. While here he was also elected a member of the American Philosophical Society.

Immediately on his return to Philadelphia he began the practice of medicine, and (1789) when but twenty-four years of age was elected Professor of Natural History and Botany in the College of Philadelphia, the Chair having been created with the object of acquiring his services. This was probably the first Chair in Natural History in America, although not the first in Botany. When the University of Pennsylvania and College of Philadelphia united (1791), the professorship was retained by Barton, and held by him until his death. In 1798 he was appointed one of the physicians in the Pennsylvania Hospital, which position he also held during the remainder of his life. It is evident that Dr. Barton aspired to the highest of honors, and worked tenaciously to qualify himself to receive them. Thus it was that when the celebrated Professor Rush died in 1813, Barton applied for the position, and was elected Professor of "The Theory and Practice of Medicine, and of Institutes and Clinical Medicine."

But he was not destined to do more than step into the place, make his bow, and pass away. During his early years he was often ill, being afflicted with hemorrhages and gout. During after-life he studied hard and persistently, "the pernicious consequences of his midnight and injudicious toils" sacrificing his strength and vitality. A severe hemorrhage was sustained during the time he was engaged in preparing his new series of lectures, and after delivering two courses, increasing ill health forced him to seek for relief by means of a sea voyage. He sailed for France in April of 1815, returning by way of England in November, disheartened. On landing at New York he was afflicted by hydrothorax, and detained in that city three weeks. Finally, reaching home a very sick man, he took to his bed, became rapidly worse, and was found dead the morning of December 19, 1815. And yet, notwithstanding his illness, accompanied by violent hemorrhages from the lungs, he persisted in working, and three days before his death wrote a paper concerning a genus of plants named in his honor, which was read by his nephew, W. P. C. Barton, at the following meeting of the American Philosophical Society.

In considering the contributions to science and the work of Benjamin S. Barton, one is struck by the variety of subjects. He was "an indefatigable student and writer." He was a mutual friend of both Pursh and Nuttall, contributing much towards their success as botanists in the study of the plants of North America. Thus Frederick Pursh, in his *Flora Americana Septentrionalis* (London, 1814), credits Barton with supplying the funds which enabled him to take a botanical excursion, which he describes to the effect that he started the first of 1805, traversed the mountain chains of Virginia and Carolina, returning through the coast lands, reaching Philadelphia late in the autumn. Concerning Thomas Nuttall, Barton remarks:

"I became acquainted with this young Englishman in Philadelphia several years ago; and observing in him an ardent attachment to, and some knowledge of botany, I omitted no opportunity of fostering his zeal, and of endeavouring to extend his knowledge. He had constant access to my house and the benefit of my botanical books.

"In 1810 I proposed to Mr. Nuttall the undertaking of an expedition entirely at my own expense, and under my immediate direction, to explore the botany, etc., of the northern and the north-western parts of the United States and the adjoining British territories. Accordingly, having provided him with a *special* passport from the President of the United States, Mr. Madison, and with whatever else I deemed necessary, together with a considerable collection of manuscript queries and memoranda, Mr. Nuttall took his departure from Philadelphia in April, 1810.

"His route was by Pittsburg to Detroit, Michilimakinak, Fox River, the Falls of St. Anthony, etc. He deviated, however, from the route which had been pointed out to him, having been prevailed upon to ascend the Missouri in company with some of his own countrymen, some Americans, and others, whose objects were principally traffic.

"He proceeded to the Mikanee-town; from thence to the territory of the Mandan Indians, in the boat of a Spanish gentleman; and in the same vessel descended the Missouri to St. Louis, near the confluence of this great river with the Mississippi, in the autumn of 1811.

"Among a very considerable number of plants which he observed and collected in the course of his journey, there were two species of a genus which he observes in his notes to have the 'facies' or aspect of cactus, and which he very properly referred to the class and order of *Icosandria monogynia*—he named this genus BARTONIA. One of the species he calls Bartonia superba, and the other Bartonia polypetala. The former he found in flower in August and September; growing all the way from the river Platte to the Andes, on broken hills and the clefts of rocks—(Pursh adds, not I fear on the best authority, 'and on volcanic soil.') He speaks of it as a plant (herba) about three feet high, whose 'splendid flower expands only in the evening, suddenly opening after remaining closed during the day, and diffusing a most agreeable odour.' It may justly rank (he adds) with the most splendid plants of either America, and very probably inhabits Mexico, if not South America.

"The other species, Bartonia polypetala, he describes as a perennial, growing on gravelly hills, near the Grand Detour, and flowering in August.

"In the latter end of the year 1811, Mr. Nuttall returned to England by the way of New Orleans. Previously to his departure, he transmitted to me a number of the dried specimens and seeds which he had collected. Among these there were specimens of both species of Bartonia, together with a good collection of seeds. At the same time he sent me a manuscript book, in which he has given pretty full descriptions of the two plants by the names which I have already mentioned; viz.: Bartonia superba and Bartonia polypetala."

That Professor B. S. Barton was a man of varied attainments is shown by the fact that his papers on every subject commanded attention the world over, and won him distinction at home. To his biography, by W. P. C. Barton, we are indebted for the following list of works from his pen:

"1. De Hyoscyamo nigro—the Harveian prize dissertation, before mentioned, 1787.

"2. On the same parts of natural history, etc., etc., his first work, before mentioned, published in London in 1787—octavo, about 80 pages, with an engraving.

"3. A memoir concerning the fascinating faculty which has been ascribed to the rattlesnake, and other North American serpents; first edition, octavo, 36 pages—1796.

"4. Collections for an essay towards a materia medica of the United States. Read before the Philadelphia Medical Society, on the twenty-first day of February, 1798—49 pages octavo.

"5. Fragments of the natural history of Pennsylvania, folio, 42 pages—1799.

"6. New views of the origin of the tribes and nations of America—octavo, 165 pages—1798.

"7. Supplement to a memoir concerning the fascinating faculty which has been ascribed to the rattle-snake, and other North American serpents, in a letter to Professor Zimmerman, of Brunswick, in Germany—octavo, 38 pages—1800.

"8. Memoir concerning the disease of Goitre, as it prevails in different parts of North America; octavo, 94 pages, 1800.

"9. Collections, etc., part first, second edition—64 pages octavo—1801.

"10. Elements of botany, or, outlines of the natural history of vegetables, illustrated by 30 plates, first edition, two volumes octavo, together 508 pages—1803.

"11. Collections, etc., part second, first edition—53 pages, octavo—1804.

"12. Facts, observations, and conjectures relative to the generation of the opossum of North America, in a letter to Mons. Roume, of Paris—8vo, 14 pages—1809.

"13. A discourse on some of the principal desiderata in natural history, and on the best means of promoting the study of this science in the United States; read before the Philadelphia Linnean Society, on the 10th of June, 1807—octavo, 90 pages—1807.

"14. Some account of the Siren Lacertina, and other species of the same genus of amphibious animals; in a letter to Mr. John Gottlob Schneider, of Saxony, with an outline engraving of the animal, from a finished drawing made by myself. Octavo, 34 pages, 1808.

"15. Collections, etc. Third edition, octavo, 120 pages, 1810.

"16. A memoir concerning an animal of the class of reptilia, or amphibia, which is known in the United States by the names of alligator and hell-bender, with an engraving; octavo, 26 pages—1812.

"17. Flora Virginica: sive plantarum, præcipue indigenarum, Virginiæ Historia inchoata. Iconibus illustrata.* Pars prima, octavo, 74 pages. Printed in 1812, and going only as far as the fourth class of the Linnæan arrangement.

"18. Elements of Botany, or outlines of the natural history of vegetables, illustrated with forty plates; the second edition, first volume. 310 pages, with an index of forty pages—1812.

"19. Additional facts, observations, and conjectures, relative to the generation of the opossum of North America, in a letter to Professor J. A. H. Reimarus, of Hamburg; octavo, 24 pages—1813.

"20. Archæologiæ Americanæ Telluris Collectanea et Specimina; or, collections, with specimens for a series of memoirs on certain extinct animals and vegetables of North America; together with facts and conjectures relative to the ancient condition of the lands and waters of the continent; illustrated by engravings. Part first, octavo, 64 pages—1814.

"21. Elements of Botany, second volume, in 1814.

"22. Memoir concerning the fascinating faculty which has been ascribed to various species of serpents; a new edition, greatly enlarged, and embellished by a plate; quarto, 76 pages—1814.

"23. An edition of Cullen's Materia Medica, with notes.

"24. Ditto first vol. Cullen's First Lines.

"25. Medical and Physical Journal.

Besides these separate works, the following is a list of his papers and memoirs, read to the American Philosophical Society, and printed in the different volumes of the transactions of that society:

"1. An account of the most effectual means of preventing the deleterious consequences of the bite of the crotalus horridus, or rattle-snake. Philo. Trans. vol. 3d, pages 14 quarto.

"2. An inquiry into the question whether the apis mellifica, or true honey-bee, is a native of America. Ditto, 20 pages, quarto.

"3. A botanical description of the podophyllum diphyllum of Linnæus, in a letter to Charles Peter Thunberg, M. D., Knight of the Order of Wasa, Professor of Medicine and Botany in the University of Upsal, etc. Ditto, 14 pages quarto, accompanied with a plate of the plant to which Dr. Barton gave the name of Jeffersonia, in honor of Thomas Jefferson.

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* There are no plates in it.

"4. An account of the fascinating faculty which has been ascribed to the rattle-snake and other North American serpents. Vol. 4th of the Philo. Trans. 40 pages quarto. (This paper afterwards appeared in the form of a separate work, as has been mentioned, and went through two editions.)

"5. Some account of an American species of dipus or jerboa. Ditto, with an engraving of the animal. 11 pages quarto.

"6. Observations and conjectures concerning certain articles which were taken out of an ancient tumulus or grave, at Cincinnati, in the county of Hamilton, and territory of the United States, northwest of the Ohio; in a letter to Dr. Priestley. Ditto, 36 pages quarto.

"7. Hints relative to the stimulant effects of camphor upon vegetables. Ditto, 3 pages quarto.

"8. Some account of the poisonous and injurious honey of North America. Vol. 5, Phil. Trans. 16 pages quarto.

"9. Memorandum concerning a new vegetable muscipula. Vol. 6, Phil. Trans. 3 pages quarto.

"10. Some account of a new species of North American lizard. Ditto, 5 pages quarto, with an engraving of the animal.

"11. Supplement to the account of the dipus Americana, in the 4th vol. of the transactions of the Am. Ph. Society. Ditto, 2 pages quarto.

"12. Hints on the etymology of certain English words, and on their affinity to words in the languages of different European, Asiatic, and American (Indian) nations, in a letter to Dr. Thomas Beddoes. Ditto, 13 pages.

"13. At a special meeting of the Philosophical Society, February 24, 1804, Dr. Barton was chosen to deliver an eulogium upon Dr. Priestley.

"14. In February, 1800, he read to the Am. Phil. Society an extensive memoir, entitled "A geographical view of the trees and shrubs of North America."

"15. A memoir (which gained the Magellanic premium) concerning a considerable number of pernicious insects of the United States.

"Professor Zimmerman translated into German the memoir (Transactions Phil. Society) on the bite of the rattle-snake. Also the memoir on the fascinating faculty of the rattle-snake, etc., to which last he added notes, and an introduction in the German language of 22 pages duodecimo.

"The Elements of Botany have been republished in London, and translated into the Russian language at St. Petersburgh."

Professor Barton married (1797) a daughter of Mr. Edward Pennington, of Philadelphia, two children, a boy and a girl, and the mother, surviving him. The son, Thomas Pennant Barton, was "American Chargé d'Affaires at Paris, July, 1836."

Two portraits of Professor B. S. Barton are in existence, one an engraving in his biography by his nephew, W. P. C. Barton, the other being in the Philadelphia Academy of Natural Science.

The portrait we present is from the *Popular Science Monthly*, and a reproduction of that in his biography. It presents the forcible, thoughtful face of a cultured gentleman of Colonial times.

In this connection it may be well to let his nephew, the biographer alluded to, give the description of the man and his methods:

"The ardent thirst for literary fame, which strongly marked the character of Professor Barton through life, rendered him a most indefatigable student from his earliest youth. He read much, wrote a great deal, and contemplated nature with unceasing attention. His numerous publications afford, of themselves, sufficient proofs of an uncommon degree of industry; but, besides these, he was long engaged in collecting materials for other works, and preparing some for the press; all of which, it is greatly to be regretted, will now probably be lost to the world.

"Amidst his professional avocations, which were numerous—the duties of his station as a medical teacher, which were arduous—and a considerable portion of his time that was occupied in keeping up an epistolary correspondence with distinguished men of science,* as well in the old world as in his own country—amidst all these occupations, it is a matter of surprise, that he could have found a sufficiency of leisure for his multitudinous pursuits in literature and science: and the more especially when it is taken into view, that he was frequently impeded in these pursuits by the privation of health.

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*Among the most distinguished of these are the following named:

The count de la Cépède, peer of France, etc., to whom Dr. Barton dedicated the quarto edition of his memoir on the fascinating faculty of the rattle-snake.

Professor E. A. W. Zimmerman, of Brunswick, in Germany.

Professor J. A. H. Reimarus, of Hamburg.

Professor John Frederick Blumenbach, of Göttingen, to whom he dedicated his memoir on the disease of Goitre.

Mr. Thomas Pennant, the celebrated author of Arctic Zoology.

John Mason Good, Esq., F. R. S., etc., surgeon, of London, (well known by his poetical version of the songs of Solomon)—to whom he dedicated his Archæologiæ Americanæ Telluris, etc.

Dr. James Edward Smith, the learned president of the Linnæan Society of London, to whom he dedicated the second editition of the first part of his Collections, etc.

Professor Autenrieth, of Tübingen.

Mr. Tilesius, an eminent naturalist of St. Petersburgh, Russia.

Monsieur Roume, of Paris, an intelligent French naturalist.

Mr. John Gottlob Schneider, of Saxony, a late celebrated writer on amphibious animals.

Dr. Patterson, of Londonderry, in Ireland.

Monsieur G. Cuvier, of Paris, the illustrious author of many learned works on organic geology, etc.

Sir Joseph Banks, Bart., the well-known liberal and munificent patron of literature and science.

Dr. John Walker, Professor of Natural History in the University of Edinburgh.

Baron Humboldt.

Professor Pallas, of Russia.

Professor Sparrman, Sweden.

Professor Thunberg, Sweden.

Professor Burmann, of Holland.

"Natural history and botany were his favorite studies,* and in his investigation of these branches of science he made a conspicuous figure. He employed much research respecting the origin of the tribes and nations of America, on which subject he has, I am persuaded, left many valuable manuscript materials. He was fond of investigating what may be termed the *antiquities* of this country; and particularly interested in zoological inquiries.

"He was a skeptic in matters of science depending on human testimony—in fact, his incredulity was astonishing. He upheld the value of skepticism in his lectures, and in one of his publications he thus expresses himself: 'Credulity is the most injurious feature in the character of the naturalist, as well as of the historian. Its influence, in one individual, is often felt and propagated through many ages. Unfortunately, too, it has been the vice of naturalists, or those who have touched on questions relative to natural history.'

"The genius of Dr. Barton was of the highest grade: it was rapid, comprehensive, and brilliant in the extreme. He was well aware of the inefficacy and fruitlessness, however, of its unaided efforts; he did not rely, therefore, on the native powers of his mind alone, great as they were, but applied himself closely to the avocations of the closet. He was not only a man of extraordinary industry, but of quick perception and various information. His genius prompted him to conceive with celerity all the varied and diverse relations of those subjects to which the bent of his mind more particularly attached him—he was, therefore, a rapid writer. He possessed a memory remarkably, nay, extraordinarily tenacious and faithful, particularly with respect to facts and chronological events. He never forgot what he once determined to remember, hence he read with great advantage; and though his reading was always desultory, irregular, and to all appearance hasty, he was able to make the most profitable use of it. He possessed a good judgment, much imagination, and a taste for the fine arts. He was indeed a man of uncommon genius and excellent professional talents.

"As a medical teacher, he was eloquent, instructive, and, when occasion called for it, quite pathetic. His voice was good, though attenuated, penetrating, and sometimes rather sharp; his enunciation clear and distinct; his pronunciation constrained, and his emphasis, owing to his remarkable kind of punctuation and a desire to be perspicuously understood, was studied, forced, and often inappropriate. In his lectures his diction was cacophonous and unpleasant.

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* In the preface to his Elements of Botany he thus speaks of his attachment to these sciences: "The different branches of natural history, particularly zoology and botany, have been my favorite studies from a very early period of my life. The happiest hours of near sixteen years of cares, of difficulties, or of sickness, have been devoted to the cultivation of these interesting sciences. During this long period I have never ceased to look forward, as I still look forward, with an ardent satisfaction to the time when natural history (including botany) shall be taught as an indispensable branch of science in our University. That period, however, has not yet arrived. I have, however, the satisfaction of observing that these sciences are making some, nay, even great advances among us; and I still flatter myself that the directors of our principal American universities, or other seminaries of learning, but *in particular, the trustees of the University of Pennsylvania* (in which all the branches of medicine are taught much more extensively than in any other part of the United States), will see the *propriety*, and even *necessity*, of giving *more substantial encouragement* for the extension of natural history among us."

"As a writer, he is ingenious, rich in facts, profound in research, and always abounding in useful information. He wanted, however, in a great degree, a talent for generalizing. Hence his various works are characterized by an egregious want of method, or perspicuous arrangement. His style, it must be confessed, is always diffuse, inelegant, and frequently tautological. As he never corrected what he once wrote, or at least but rarely, these defects in his composition were the natural consequences of his vehemence in writing. His punctuation is truly remarkable, and, for a man of his discernment and extensive reading, singularly incorrect.

"As a physician, he discovered a mind quick in discriminating disease, skillful in the application of appropriate remedies, though he certainly was a very cautious, if not timid, practitioner. No man read more extensively on the subject of diseases; in fact, he was deeply versed in pathological knowledge, derived from books. As, however, his medical practice was never very extensive, his practical observations delivered in his lectures were strikingly marked with the evidences of overweening caution. Hence he recommended to his pupils, and always employed himself, unusually small doses of medicine. He was, however, in the main, an observing and intelligent practitioner, and was remarkably assiduous in his attentions, and soothing in his behavior to his patients.

"In figure he was tall, and exceedingly well formed; in middle life he might be considered as having been handsome. His physiognomy was strongly expressive of intelligence, and his eye was remarkably fine and penetrating.*

"In temperament he was irritable and even choleric. His spirits were irregular, his manners consequently variable, impetuous, vehement. These repeated vacillations between equanimity and depression, were generally owing to the sudden and repeated attacks of his continual earthly companion—irregular gout.

"In familiar conversation he was often elegant, remarkably facetious, but never witty.

"As a parent, he was kind, tender, and indulgent to a fault.

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*The best likeness extant of Dr. Barton is the fine profile, done in mezzotinto, by St. Memim (the engraving prefixed to this sketch is copied from it) when the doctor was about thirty-seven years of age. The life-size crayon profile, from which the miniature mezzotinto was taken, is also a very good likeness: it is the property of the Pennsylvania Hospital, where it now is. His portrait of *kit-kat-size*, was painted while in England, by his ingenious friend and early protégé, Mr. Jennings: this was, at the time it was taken, a good likeness. And another, in a more finished style of painting, though certainly not a happy resemblance, was painted by Mr. Rembrant Peale, within the last two years of the doctor's life. Mr. Trott painted a fine miniature picture of him, which is in all respects, except the expression of the mouth, a most excellent likeness.

The execrable caricatures, now exposed for sale in the print-shops and book-stores, have only the most distant traces of resemblance.

"He possessed some high virtues; among the most elevated of them was his unaffected love of country. Indeed, his patriotic feelings were not only strong, but frequently expressed with unreserved warmth. He always spoke with extreme impatience of the arrogance of pretending foreigners of the literary grade, too many of whom resort to our country, being nothing in their own, and perpetually insult us by their vain and insufferable denunciations of our claims to national genius, talents, and learning."

That Professor Barton possessed not only a local and an enviable reputation abroad by reason of his labor in science is shown by the fact that he was a member of the Imperial Society of Naturalists of Moscow, the Linnæan Society of London, the Society of Antiquaries of Scotland, the Danish Royal Society of Sciences, and the Royal Danish Medical Society.

Several biographies of Professor B. S. Barton have appeared, among which the following are most prominent, being the works consulted in this study:

Biography of Dr. W. P. C. Barton, in the revised "Elements of Botany," 1836. From this work, it seems, all the other biographies, including our own, have been largely constructed.

A History of the Medical Department of the University of Pennsylvania, 1869, by Joseph Carson, pp. 126.

Sketch of Benjamin Smith Barton, *Popular Science Monthly*, 1896, p. 834 (portrait, p. 720). Our portrait is copied from this print.

The Botanists of Philadelphia and Their Work, by John W. Harshberger, Ph. D., 1899, pp. 108.

Having thus briefly recounted the part taken by Dr. Benjamin Smith Barton in scientific affairs about one hundred years ago, we may add that, in our opinion, no other man in early American medicine made a more marked and lasting impress. His were the first efforts of any American teacher to call attention to our indigenous remedies in a prominent or systematic way.

The result of his guidance is seen in the numbers of theses on medico-botanical subjects that were evolved from the University of Pennsylvania during the period of his connection with that institution, a work that still redounds to its honor and credit.

"Barton's Collections" are referred to by all who study the history of American drugs, being the first English work on the subject. Long since out of print, this is a very rare volume.

COLLECTIONS

FOR

AN ESSAY

TOWARDS A

MATERIA MEDICA

OF THE

UNITED-STATES.

READ BEFORE THE PHILADELPHIA MEDICAL SOCIETY, ON THE TWENTY-FIRST OF FEBRUARY, 1798.

BY BENJAMIN SMITH BARTON, M. D.
ONE OF THE HONORARY MEMBERS OF THE SOCIETY,
AND
PROFESSOR OF MATERIA MEDICA, NATURAL HISTORY, AND BOTANY,
IN THE UNIVERSITY OF PENNSYLVANIA.

"Sunt Simplicia desumpta e triplici Naturæ Regno: e Lapideo, Vegetabili & Animali; heic VEGETABILIA tantum depromsi, quæ maximam constituunt Materiæ Medicæ partem, alio tempori reservans cetera."

LINNÆUS.

FIDEM NON ABSTULIT ERROR.

PHILADELPHIA:

PRINTED, FOR THE AUTHOR,
BY WAY & GROFF, No. 27, ARCH-STREET.
1798.

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TO

JAMES EDWARD SMITH, M. D. F. R. S.

PRESIDENT OF THE LINNÆAN SOCIETY,

MEMBER OF THE ROYAL ACADEMIES OF TURIN, UPSAL, AND LISBON;

AND

MEMBER of the AMERICAN PHILOSOPHICAL SOCIETY, &c.

DEAR SIR,

I CANNOT expect to add any thing to your reputation, by dedicating to you the following pages. I mean not, by this act, to choose a patron who shall veil my faults, or screen me from the censure of the public critic. The actions of men, particularly perhaps of young men, are sometimes disinterested. It is with pleasure I declare to the public, how much I admire your exertions for the extension of that amiable science which both of us cultivate: you with the happiest success; I with an humble ardour.

THE age in which we live is the age of natural science. The mind of LINNÆUS has effected more than the combined intellects of all the naturalists of any preceding century. Natural history, however, is still an infant science. This is particularly the case with respect to America. Even the *nomenclature* of our productions is extremely imperfect. We are still less acquainted with the *properties* of our productions. I view this blank in the history of science, with pain. This pain, however, is daily diminished: for something is daily added to the stock of our knowledge.

I AM far from insinuating, that what I offer you is important in its kind. I am fully sensible of the imperfections of this Essay. I could wish it were more worthy of your attention. If I succeed in convincing you, that there are some lovers and cultivators of botany in the United-States, one of my objects in writing this dedication will be accomplished.

ACCEPT of my sincere wishes for your happiness, and believe me to be, with great respect,
Dear Sir,
Your friend and humble servant, &c.
BENJAMIN SMITH BARTON.

Philadelphia,
March 12th, 1798.

PREFACE.

I HOPE the following pages will be received as an earnest of my desire to extend our knowledge of the medical properties of the indigenous vegetables of the United-States. I do not expect to acquire any reputation by the publication. Perhaps, in making this assertion, I shall not be doubted, when I confess that in every thing which I have hitherto published, I have had reputation in view. If I have not acquired it, I have borne the disappointment with tranquil indifference.

THE readers of these *Collections* (for every thing that is written and published solicits some readers), will form different opinions about my medical faith. Some of them will think I have too much; and others that I have not enough. I certainly do not repose implicit confidence in the half of what is said concerning the powers of medicines. Accordingly, I have not given a place in these pages to many of our vegetables which have been praised as specifics for the cure of diseases; in particular, as specifics against the bites of venomous serpents. But, on the other hand, it will be asked, whether I mean that all the different vegetables which I have mentioned, should have a place in the materia medica of physicians? I answer, No. But how are we to know what plants are most proper for the purposes of medicine, until we shall have examined the properties of a great body of vegetables? The Digitalis is now thought one of the most important of the diuretic medicines: but perhaps future inquiries will discover a diuretic which shall, in a great measure, supersede the frequent use of this active plant. I wish to turn the attention of our physicians to an investigation of the properties of their native productions. When it is considered how little has hitherto been done in this way, every attempt (mine is an humble one) should be candidly received. I do not mean that its faults should not be pointed out.

THE arrangement of the articles which I have mentioned is by no means faultless: on the contrary, it is liable to many objections. I should not have followed this arrangement had I been considering *all* the articles of the materia medica. I shall give a sketch of my ideas of a method of the science, in my strictures on the arrangement of the learned and elegant author of the *Botanic Garden*, a poem which unites the fire of Lucretius with the taste of Virgil, and a learning unequalled by that of Camoëns or of Milton.

I THINK it but candid to confess, that since reading this address to the Medical Society, I have made some alterations in it. These alterations, however, are very inconsiderable. In general, even the very style and faults of each phrase are preserved, for I had not time to alter or correct much. I have left out the concluding part of the address, relative to the establishment of a medical library: not that I doubt the ability of the society to form a library of its own. The notes contained in the appendix were not read to the society.

WHATEVER may be the reception of this essay by the public, whether favourable or unfavourable, I shall pursue my inquiries concerning the nature and properties of the natural productions of my native country. I shall pursue them, because there is at least a possibility that they may ultimately tend to something useful: and because I have the experience of several years to teach me, that the cultivation of science is the extension of my happiness.

ERRATUM.

Page 13. *For* Cornus Cincinata, *read* Cornus circinata.

COLLECTIONS, &c.

GENTLEMEN,

WE have assembled together to celebrate the anniversary of our foundation. It is an occasion which ought to give pleasure to us all. We have met, however, for the difficult purpose of mingling science with pleasure. This difficulty falls peculiarly upon me. By your vote, I have been called upon to deliver the annual discourse. I accepted of the appointment cheerfully, because I was anxious to demonstrate my attachment to the Society, of which I had the honor to be a member at a very early period of my life; a Society in which I first imbibed my love of the different sciences which constitute the great fabric of medicine.

BUT if I accepted of the appointment with pleasure, I do not address you with confidence. I have found it difficult to select a subject for your entertainment. I, at one time, contemplated a comparative view of the different theories which have prevailed in medicine, in the present century. But I soon found this subject too extensive for our purpose: besides, in the investigation of this view, I should have been obliged to speak with a freedom, which might not have given pleasure to every one of us. Men are often attached to theories, as parents are attached to their children.

AFTER some difficulty, I have selected a subject. It is An Essay towards a materia medica of the United-States; or, if you please, An Inquiry what indigenous vegetables of our country may be used with advantage in the treatment of diseases. This, you will immediately perceive, is a task both extensive and difficult. But it is an important one. I shall not, perhaps, perform a duty altogether unacceptable to you, if I furnish you with a few facts not generally known to you before. This is all I aim at.

MINE is not the first attempt of this kind. Besides the paper entitled *Specifica Canadensium*,* Dr. Schoepf, of Erlangen in Germany, has favoured us with a specimen of such a work, under the title of *Materia Medica Americana potissimum regni vege-*

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* See Amoenitates Academicæ. Vol. iv. Dissertatio lxxii.

tabilis. This work was printed in 1787. The author arranges the articles according to the sexual system of Linnæus. This, though an objection, is not the greatest. He has given us nothing from his own experience. He ascribes active powers to plants which are nearly inert, and appears to me to be, in some measure, governed by the old notion of Signatures: one of the tyrants of the ancient schools. He discovers none of that infidelity, or, if you please, scepticism, which ought ever to be attached to physicians: I mean not an infidelity relative to religion; but an unwillingness to acquiesce, without good proofs, in the truth of every tale concerning the powers of medicines. This pliant, this credulous disposition, has been one of the causes which have obstructed the regular march of medical science. But as the effort of Schoepf is the best of the kind, so we ought to tread lightly on his work. He is at least a man of learning; and learning should always claim indulgence from the lovers and cultivators of science.

I AM far from supposing that it is in my power, especially on this occasion, to supply all the defects of Schoepf's book. It would be easy to point out its faults. I aim at a rude sketch of our materia medica. It is so extremely unfinished, that I have no objection to its being called by any inferior name. I confine myself entirely to vegetables.

MATERIA ALIMENTARIA.

YOU are all acquainted with the great general division of the materia medica into two parts: that which relates to the aliments, or *nutrientia*, of mankind, and the medical part, more strictly so called. Each of these is highly important; but I mean in this address to confine myself almost entirely to the latter branch. Yet the former should claim some of our attention. Much may be expected from a country which has blessed us with the maize, the potatoe, &c. I could readily furnish you with a long list of the indigenous nutrientia of this country; but such a list would be very uninteresting. On this subject, however' an useful work might be written. He who shall undertake to examine the subject extensively will find, that Providence has, in the gift of esculent vegetables, been as liberal to the countries of the United-States, as to any other countries of the world, of equal extent.

UNDER this head of the nutrientia, I shall content myself with mentioning two native articles, which deserve the attention of physicians and others. Perhaps they may even supersede, on many occasions, the use of some other articles, which are purchased at a pretty dear rate.

There grows upon the river Mobile a species of palm, which is but little known to naturalists, but which promises to be an important article of food to man. It has no stalk or stem above ground. The leaves spread regularly all round, and when fully expanded are flabelliform. In the centre of these leaves is produced the receptacle of the fruit, which is of the form and size of a common sugar-loaf. This receptacle consists of a vast number of drupes, or berries, of the size and shape of common plumbs: each is covered with a fibrous, farinaceous, pulpy coating of considerable thickness. This substance is said to resemble manna in texture, colour and taste; or, perhaps, it still more resembles moist brown sugar, with particles of loaf sugar mixt with it. It is a most delicious and nourishing food, and is diligently sought after in the places where it grows. Upon first tasting it, it is somewhat bitter and pungent.*

The large tuberous roots of the Smilax China afford our southern Indians a nourishing food. The fresh roots are well macerated in wooden mortars. The mass is then put into vessels nearly filled with clear water, where it is well mixed with paddles. It is decanted off into other vessels, where it is left to settle, and after the subsidence is completed, the water is cast off, leaving the farinaceous substance at the bottom. When this is taken out and dried, it is an impalpable powder of a reddish colour. Mixed with boiling water, it becomes a beautiful jelly, which, when sweetened with honey or sugar, affords a most nourishing and pleasant food for children or aged people. The Indians sometimes use it mixed with fine corn-flour, and fryed in fresh bears' oil.*

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* From the information of Mr. William Bartram. MS *penes me*. Vol. i.

THE chemical history of the maize, or Indian corn, the blessing of our country, deserves to be farther investigated. Its importance as an article of diet is sufficiently established by the experience of whole nations.

MATERIA MEDICA.

I AM not very anxious, on this occasion, about my division of the materia medica. I have attempted, in my lectures, to make some improvements upon the arrangement of Dr. Cullen; and, if I live, I hope to publish, in a few months, my strictures on the late arrangement of the ingenious Dr. Darwin. At present, in possession of only a small collection of original facts immediately relative to the materia medica of the United-States, I shall content myself with disposing of these facts under the nine following heads, viz. 1. ASTRINGENTS; 2. TONICS; 3. STIMULANTS; 4. ERRHINES; 5. SIALAGOGA, or SALIVATING MEDICINES; 6. EMETICS; 7. CATHARTICS; 8. DIURETICS; 9. ANTHELMINTICS.

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* From the information of Mr. William Bartram. MS *penes me*. Vol. i.

SECT. I. ASTRINGENTS.

I THINK it proper, in the present state of our knowledge of medicines, to give place to a class of ASTRINGENTS. There is the more propriety for the adoption of such a class, because we see more readily, than with respect to many other medicines, their direct mode of operation. Our vegetable astringents, I mean the purer and more unmixed astringents, are numerous. The barks of all our oaks are of this kind. But I may here particularly mention three or four native astringents, which seem to be more especially entitled to your attention.

THE first is the Geranium Maculatum, or Spotted Geranium, which grows very plentifully about this city: it flowers in the spring. The root is used: this boiled in milk has been found an excellent medicine in the cholera of children. It is not necessary to be very nice about the dose. I imagine it would also prove useful in old diarrheas, where the kino, and other astringents are exhibited. If nephritis, of certain kinds, be relieved by astringents, this geranium would seem entitled to attention, not merely because it is a powerful astringent, but because a species of the same genus, the Geranium robertianum, or Herb-Robert, has been employed with advantage in this distressing complaint.*

The Heuchera Americana is the next astringent. This is sometimes called American Sanicle. It is more commonly called Alum-Root. The root is a very intense astringent. It is the basis of a powder which has lately acquired some reputation in the cure of cancer. I suppose all its virtue, in this case, depends upon its astringency. I may here observe, that the disease of cancer is not confined to civilized nations. It is known among our Indians. I am informed that the Cheerake cure it with a plant which is thought to be the Hydrastis Canadensis, one of our fine native dies. I do not believe that the Heuchera has cured genuine cancer: but it seems certain that it has proved very beneficial in some obstinate ulcers, which have been mistaken for cancer. In such cases, the astringent medicines are too much neglected.

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* I am not certain that the Geranium robertianum is a native of any part of America.

THE Actæa racemosa, or Black Snake-root, is also a valuable medicine. It is sometimes called Squaw-root, I suppose from its having been used as a medicine by our Indians. The root of this plant is considerably astringent. In a putrid sore throat which prevailed in Jersey, many years ago, a strong decoction of the roots was used, with great benefit, as a gargle. Our Indians set an high value on it. A decoction of it cures the itch. In North-Carolina, it has been found useful, as a drench, in the disease of cattle called the murrain.

THE Uva Ursi* is considerably astringent. Yet I suspect that it does not operate entirely by virtue of its astringent quality. This plant, from my own experience, I can recommend to you as a most valuable medicine. It should be in the hands of every physician. I have used it with advantage in old gonorrhea. But its great virtue is that of a medicine in nephritis. I am inclined to think that it is peculiarly adapted to cases of what I call nephritis podagrica, or nephritis depending upon gout. This is one of the plants which is common to the old and to the new-world. It grows plentifully in Canada, New-York, New-Jersey, &c. Schoepf says, the Indians mix the leaves with tobacco.†

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* Arbutus Uva ursi of Linnæus. † Page 68.

THE Liquidambar asplenifolium* of Linnæus is well known by the name of Sweet-Fern. It has often been found useful in diarrhea. Other virtues have been ascribed to it.†

SECT. II. TONICS.

I BELIEVE all the astringent medicines are more or less TONIC. But there are a good many tonics which are not astringent. There is, certainly, some propriety in considering the astringents and tonics under two distinct heads, as Dr. Cullen has done. But, perhaps, the tonics should only form one section of the great class of stimulants. Certain it is, that many of the tonic medicines are considerably stimulant.

THE class of tonics is extremely interesting to physicians. It embraces some of the most valuable medicines with which we are acquainted, such as the Peruvian bark, the extensive tribe of bitter medicines, as the gentians, &c. The natural infirmities of mankind, and perhaps especially the vices to which civilized nations are so propense, will always render the tonics most necessary implements in the hands of physicians.

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* Comptonia asplenifolia of Aiton. † See Schoepf, p. 142.

Our woods possess several medicines which I am inclined to think might to be used, with advantage, as substitutes for the Peruvian bark. Perhaps, most of our Oaks, which are in general different from the oaks of the old-world, are of this kind. Sufficient trials have not been made with them; at least *internally* used. *Externally* some of them have been employed with advantage. I have used the bark of the Spanish oak* in gangrene, and I had every reason to think it was, in this case, equal in power to the best Peruvian bark. The bark of the Prunus Virginiana, or Wild-Cherry-tree, has been used in intermittent fevers, and found useful. This is a very common tree. Its leaves are poisonous to certain animals, as calves. Even the berries intoxicate different kinds of birds. The barks of the Common Sassafras (Laurus Sassafras) and Persimmon (Diospyros Virginiana) have likewise been found useful in intermittents. In the year 1793, I used the bark of the last of these vegetables in an ulcerous sore throat.† Our Willows have not been attentively examined. We have several native species, and I believe they possess nearly the same properties which have been ascribed to the willows of

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*Quercus rubra montana of Marshall.

†Dr. Woodhouse has favoured us with some interesting information concerning the Persimmon. See his Inaugural Dissertation. Philadelphia. 1792.

Europe,* by Stone, Haller, and other writers. The Dogwood is a genus which seems well worthy of attention. Of this, the Cornus of the botanists, there are several species in North-America. The most common is the Cornus Florida, or Common Dogwood. I find this in every part of the United-States. It is one of our most beautiful shrubs. It flowers early in the spring, and with so much regularity, that some of our southern tribes were accustomed to name the spring season from its flowering. The bark is considerably astringent. It has long been employed in intermittent fevers. A decoction of it has also been employed, and found very useful, in a malignant fever, called the yellow water, Canada distemper, &c. which, within the last eight years, has carried off great numbers of the horses in the United-States. The ripe fruit, or berries, infused in spirit or brandy, make an agreeable bitter. Our Indians employ an infusion of the flowers in intermittents. The same infusion has been much recommended by some in flatulent cholic. I have used it as a tea.

The Cornus sericea, another species, is called Red-Willow and Rose-Willow; which are very improper names. The bark of this is often mixed with tobacco and smoken by the savages. It has

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‡ Particularly the Salix alba, Salix pentandra, Salix latifolia, &c.

been found but little inferior to the common pale Peruvian bark, in intermittent fevers. This species grows in wet places, on the sides of rivers, creeks, &c. and flowers in August and September. I know nothing of the medical properties of the other native species of this genus; viz, Cornus Canadensis, Cornus Cincinata, &c.

MANY years ago, Zannichelli, and of late, Cusson and other writers, recommended the bark of the Æsculus Hippocastanum, or Common Horse-Chesnut, as a substitute for the Peruvian bark. This Æsculus is not a native of America, though it thrives very well in the open ground of Pennsylvania, &c. But we have at least two native species of the same genus within the limits of the United-States.* Whether the bark of these possess the properties which have been ascribed to the Hippocastanum, I do not know. They deserve to be examined.

I MUST not omit to mention, under this head, the Magnolias. Of this fine genus, we have at least six species, viz. the Magnolia glauca, the acuminata, the tripetala, the grandiflora, the auriculata, and the Fraseri. I believe they all possess nearly one general assemblage of properties; but of this I am not quite certain. The species that is best known to me is the glauca, commonly called Magnolia, Beaver-tree, and Swamp-Sassafras. The bark of this is an agreeable aromatic, tonic, bitter medicine. It has been used in intermittent fevers. The flowers have a powerful and to most persons an agreeable smell. It is an emanation which must be considered as a potent stimulant, or incitant. I am well acquainted with a physician in whom the newly-expanded flower evidently increased the paroxysm of a fever which came on every afternoon; and also increased the pain of inflammatory gout. This is an interesting fact. In Virginia, a spirituous tincture of the cones, or seed-vessels, of the Magnolia acuminata, which is commonly called Cucumber-Tree, has been used, and we are told very advantageously, in rheumatic complaints.* The bark of the root of the Magnolia grandiflora, sometimes called Tulip-tree, is used in Florida, in combination with the Snake-root, as a substitute to the Peruvian bark, in the treatment of intermittent fevers. The flowers of the Magnolia tripetala, or Umbrella-tree, have a very powerful smell. They often induce nausea and head-ache.

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* **Æsculus Pavia of Linnæus, and Æsculus flava of Aiton.**

I AM inclined to think that the Cortex Angusturæ, which has lately been introduced into medical practice, and is so greatly celebrated as a tonic, by the practitioners of Britain, is the bark of some species of Magnolia.

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* See Dr. Duncan's Medical Commentaries, for the year 1793. Vol. xviii, p. 445.

THE Liriodendron Tulipifera, well known in the United-States, by the names of Tulip-Tree, Poplar, White-Wood, &c. is very closely allied, by its botanical character, to the Magnolias. They both belong to the same class of the sexual system, and both, I believe, possess nearly the same properties. The bark of the Liriodendron is sometimes used in intermittents. Many persons are of opinion, that in this case, it is but little inferior to the Peruvian bark. I have never employed it.

THE bark of the Populus tremula? or Aspin? has likewise been used in cases of intermittent fevers. This is a powerful tonic, and deserves the attention of the American physician. It has been found very useful, as a stomachic, in the diseases of our horses.

THE Snake-root, the Aristolochia Serpentaria, is one of the more stimulating tonic bitters. It is certainly a valuable medicine, in the second stage of certain fevers, after the inflammatory diathesis has been removed. It was used with great benefit, in a most malignant fever, attended with carbuncles, which prevailed at Bristol, on the Delaware, in this state, in the years 1749 and 1753. Another species of this genus, the Aristolochia sipho of L'Heritier, grows in the neighbourhood of Pittsburg, and in other parts of the United-States. This is a large, climbing plant. The root has a pungent, aromatic taste, and for certain purposes is perhaps preferable to the common Snake-root.

I SHALL conclude this subject of tonics by observing, that we possess a good many of the bitter plants of Europe, which have long claimed the attention of physicians. Our Gentians have not been carefully examined. We have one species which appears to be equal to any of the officinal kinds yet known.

SECT. III.

STIMULANTS, OR INCITANTS.

THE class of STIMULANTS, or INCITANTS, is so very extensive, that in order to exhibit a methodical or natural medical arrangement of these articles, it would be necessary to consider them under a number of different heads, or sections. But this, in such a sketch as I offer you, does not appear necessary. I shall content myself, therefore, with speaking of a few of our native stimulant vegetables, under the two heads of such as are more general, and such as are more partial, or topical, in their operation.

GENERAL STIMULANTS.

I THINK that many of our different balsamic products may, with propriety, be considered under the head of GENERAL STIMULANTS, though they are certainly not the most diffusible articles of this class. Such is the resin of the Populus balsamifera, called Balsam, or Tacamahaca-Tree. This is a native of North-America and of Siberia. The resin is procured from the leaf-buds. This balsam is so very penetrating, that it communicates its peculiar smell and taste to the flesh of certain birds which feed upon the buds. It was formerly supposed, that the Tacamahaca of the shops was the produce of this tree. But it seems more probable that it is the produce of the Fagara octandra.

THE gum-resin which exudes from the Sweet-gum, or Maple-leaved Liquidambar-Tree, the Liquidambar Styraciflua of Linnæus, deserves to be mentioned. The storax of the shops is thought to be the produce of this tree: but perhaps this point is not yet quite ascertained. I am informed that the produce of our tree has been used, with advantage, in diarrheas. Some of our southern Indians mix the dried leaves with tobacco, for smoking.

To the head of stimulants I have no hesitation in referring a number of poisonous vegetables, with the properties of which we are not so well acquainted as we ought to be. Such are the Datura Stramonium, or James-town-weed, the Cicuta maculata, &c.

The Datura is one of our most common plants. It is certainly a medicine possessed of useful powers. The properties of this vegetable have lately been more satisfactorily investigated by one of our members, Dr. Samuel Cooper.

We have several native plants of the natural order umbelliferæ. That described by the late Dr. James Greenway, under the name of Cicuta venenosa, should be carefully investigated. This, from his account, must either be a direct sedative, or a stimulant, whose first operation is very soon accomplished. It kills without inducing pain or convulsions. Perhaps the plant with which some of our Indians, when weary of life, destroy themselves, is the same. It grows in meadows, and has a root like a parsnip.

Before I take leave of these poisonous plants, I may mention some others whose properties are but little known. The first is the Rhododendron maximum, or Pennsylvania Mountain-Laurel. This is certainly a poison. It is a species of the same genus as the Rhododendron Crysanthmum, which has lately acquired much reputation in the cure of chronic rheumatism.

NEARLY allied to the Rhododendron is the genus Kalmia. Of this we have several species, and all of them are poisons. The Kalmia latifolia, or Broad-leaved Laurel, is best known to us. It kills sheep and other animals. Our Indians sometimes use a decoction of it to destroy themselves. In the county of Lancaster, an empiric has used the powdered leaves with success in certain stages of fevers, and in tinea capitis. A decoction of the plant externally applied has often cured the itch; but it must be used with great care, for thus applied it has been known to occasion disagreeable subsultus, or startings, and convulsions. I have given the powder of this plant internally in a case of fever, and have thus, at least, ascertained that it may be used with safety.

THE medical properties of our different species of Andromeda and Azalea, which in botanical character are very nearly akin to the Rhododendron and Kalmia, are but little known to me. I have long suspected that they are poisons. A decoction of the Andromeda Mariana has been found useful as a wash in a disagreeable ulceration of the feet, which is not uncommon among the slaves, &c. in the southern states.

THE Gaultheria procumbens, which we call Mountain-Tea, is spread very extensively over the more barren, mountainous parts of the United-States. It belongs to the same class as the plants just mentioned. I have made use of a strong infusion of this plant, which is evidently possessed of a stimulant and anodyne quality. I am told it has been found an useful medicine in cases of asthma. But I have not learned to what particular forms of this disease it is best adapted, nor in what manner it operates.

OUR native species of Laurus deserve to be investigated. The Camphor and the Cinnamon belong to this genus: but hitherto, they have not been discovered within the limits of the United-States. The properties of the Common Sassafras, which is a species of Laurus, have not been sufficiently examined. It is the Laurus Sassafras of the botanists. I have already mentioned the bark. Its oil seems to be an useful medicine. I have been assured that this oil has been found an efficacious medicine, externally applied in cases of wens. This looks probable; for our medicine is nearly allied to camphor, which has been used with advantage in bronchocele.* I knew a woman in whom an infusion or tea of the root of the Sassafras always induced an oppression at breast, with sighing, and depression of spirits.

DURING the late American war, necessity drove the inhabitants, in many parts of the United-States, to seek for a substitute for some of the spices to which they had been accustomed. They used the dried and powdered berries of the Laurus Benzoin, which we call Spice-Wood, and Wild-Alspice-Bush, and found them a tolerable substitute for alspice.†

THE celebrated Gynseng, or Panax quinquefolium, may, with propriety, be thrown into the class of stimulants. I find it difficult to speak of this plant with any degree of certainty. If it were not a native of our woods, it is probable that we should import it, as we do the teas of China and Japan, at a high price.

THE Eryngium aquaticum, or Water-Eryngo, is one of the stimulants which more especially act as sudorific. It is nearly allied in its qualities to the contrayerva of the shops. It is one of the medicines of our southern Indians. They use the decoction.

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* The oil rubbed upon the head has been found very useful in killing lice. The bark, especially that of the root, powdered and mixed with pomatum, has the same effect.

† "A decoction of the small twigs makes an agreeable drink in slow fevers, and is much used by the country people. It is said the Indians esteemed it highly for its medicinal virtues." Reverend Dr. M. Cutler.

AMONG the more acrid stimulants of our country, I may mention the Arum Virginicum, or Indian-Turnip, as it is most commonly called. I could wish that the properties of this plant were examined with attention. The leaves of a plant a good deal allied to this, I mean the Dracontium pertusum of the botanists, are employed, by the Indians of Demerara, in a very singular manner, in the treatment of general dropsy. The whole body of the patient is covered with the leaves. An universal sweat, or rather vescication, is induced, and the patient often recovers. Perhaps it would be worth trying this practice in cases of anasarca, which have resisted the usual modes of treatment.*

TOPICAL STIMULANTS.

BY the TOPICAL STIMULANTS, I mean those articles which more especially increase the action or living powers of the parts to which they are applied, and which, at the same time, generally produce a discharge of fluid from the part. The Cantharis is one of these articles: but of this, as an animal body, and not a native, I have nothing to say.

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* This fact was communicated to me by my friend the late Mr. Julius Von Rohr, a gentleman whose death is a real loss to natural science, and perhaps an irreparable loss to the interests of an injured and distressed part of mankind; I mean the blacks.

THE bark of our White-Walnut, or Butternut, the Juglans cinerea of Wangenheim, is a pretty efficacious blister. The bark of the root is more powerful than that of the stem or branches. It has been applied with advantage, as a blister, to the bite of some of our venomous serpents.

I BELIEVE the bark of our Moose-wood, or Leather-wood, the Dirca palustris of Linnæus, is also a blister. This plant, by its botanical habit, is nearly allied to the genus Daphne, all the species of which are blisters; especially the Daphne Gnidium.

SOME of our Indians make use of a plant, which, when mashed a little, induces nearly as good a blister as the cantharides. It has been used with advantage in sciatica. I do not know this plant.

THE Ranunculus sceleratus, or Celery-leaved Crowfoot, is a very acrid plant. If it be bruised, and laid upon any part of the body, it will, in a few hours time, raise a blister. This plant is a native of Europe and of America. The Ranunculus bulbosus, called Bulbous Crowfoot, and Buttercups, possess the same properties. This plant grows very plentifully in our meadows and fields; but I believe it is not a native.

To this head of topical stimulants, I may refer several species of the genus Rhus, or Sumac; particularly the Rhus radicans, or Poison-vine; the Rhus Vernix, or Vernice-tree; and the Rhus Toxicodendron, or Poison-oak. In many persons they induce a peculiar and very troublesome vescication, which I have frequently removed, in a short time, by means of a mercurial wash. These plants are more active in the southern than in the northern climates. They more readily poison immediately after than before a full meal. Their stimulant effect is extended beyond the skin. It is said that the bark of one species (but I cannot tell you what species) has been found useful in intermittents.

SECT. IV. ERRHINES.

I HAVE but little to say under the head of ERRHINES, or STERNUTATORY MEDICINES. Our native vegetables of this class, with the exception of the Tobacco, are but little known to me. Of the Tobacco, as being so well known to you all, I need say nothing.

THE brown powder which is attached to the footstalks of the leaves of the Andromeda, the Kalmia, and the Rhododendron, formerly mentioned to you, is considerably errhine. The powder about the seeds in the seed-vessels of the same vegetables, possesses a similar quality. Whether this powder may be advantageously employed in practice I cannot say.

WE have many native species of the genus Euphorbia, or Spurge. There can be little doubt, that some of them are sternutative.

SECT. V. SIALAGOGA.

THE number of SALIVATING MEDICINES is, I believe, much greater than has been commonly imagined. Perhaps, there are but few of the Incitant medicines which may not be so managed as to salivate. Opium, camphor, and hemloc* all induce salivation.

I AM but little acquainted with our indigenous salivating vegetables. The Seneca Snake-root has long since been observed to possess this property.

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* Conium maculatum.

The Zanthoxylum Clava Herculis, or Ash-leaved Tooth-ach-Tree, is a very powerful stimulant. Applied to the mouth and internal fauces, it occasions a copious flow of saliva. By this property it appears to be a good deal allied to the Pyrethrum, Cochlearia, &c. I am informed that our plant is not merely an external sialagogue, but that even when taken into the stomach, it exerts its effects upon the salivary glands. I speak of the bark of the plant: but the seed-vessels have the same property. This medicine has been given internally in cases of rheumatism.

SECT. VI. EMETICS.

Among the indigenous vegetables of our country, there are several which are entitled to your attention as Emetics. Such are the Euphorbia Ipecacuanha, the Spiraea trifoliata, the Asarum Canadense, &c.

The first of these, the Euphorbia Ipecacuanha, like all the species of the genus, is an extremely active plant. It is employed as an emetic by some of the country-people. I do not know the dose. I suppose it is small, for it belongs to the head of drastic emetics. I am not certain that it would be a valuable addition to the materia medica; but, perhaps, it would. There are many cases in which we have occasion to make use of immediate and active emetics; as when certain poisons, such as laudanum, &c. have been swallowed. In such cases it may possibly be of much use.

I CAN speak with more confidence of the Spiraea trifoliata. This is a shrub, which grows very plentifully in various parts of the United-States. It is one of the few active plants of the class *Icosandria*, to which it belongs. The root, which is the part made use of, like that of the officinal ipecacuanha, consists of a cortex or bark, and a ligneous or woody part. The active power of the root seems to reside exclusively in the bark. It is a safe and efficacious emetic, in doses of about thirty grains. Along with its emetic, it seems to possess a tonic power. It has accordingly been thought peculiarly beneficial in the intermittent fever, and it is often given to horses to mend their appetite. This plant has a number of different names, such as Ipecacuanha, Indian-Physic, Bowman's Root, &c.

WE have several species of the genus Asarum, or Asarabacca. I am best acquainted with the Asarum Canadense, which is well known by the name of Wild-Ginger. In Virginia it is called Coltsfoot. Both the root and leaves may be used. The expressed juice of the fresh leaves is a powerful emetic.

SOME of our Indians also prepare an emetic from the bark of a certain vine, which a good deal resembles the Celastrus scandens of Linnæus. This vine bears bunches of red berries of a sweetish taste, but of a poisonous nature. I know nothing of this plant from my own experience; but a gentleman* who has used it prefers it to every other emetic. The Indians make a decoction of the bark. A large dose is required to produce the effect. This is certainly an objection against its use.

A DECOCTION of the Eupatorium perfoliatum, or Thorough-wort, is also emetic. I might have observed, that this plant is used by our Indians as a medicine in intermittent fevers.

THE root of the Sanguinaria Canadensis† has been mentioned to me as an emetic. I know nothing particular of this property of the plant. I should have observed, under the head of General Stimulants, that the seeds appear to possess nearly the same quality as the seeds of the Datura Stramonium.

I HAVE been assured, that the Six-Nations make use of at least twelve or fourteen different emetics.

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* Mr. John Heckewelder.

† Called, in the United-States, Indian-Paint, Puccoon, Turmeric, &c.

All them, except the sulphat of iron, are vegetables. It is probable that the Spiraea, Euphorbia Ipecacuanha, &c. are among the number of these vegetable emetics.

I SHALL conclude this subject of emetics by recommending to your attention an examination of the properties of some of our native species of Viola, or Violet. I suspect it will be found, that the roots of some of these are endued with an useful emetic quality.

SECT. VII. CATHARTICS.

WE have many indigenous CATHARTICS. Some of them are well worthy of your attention. These may be divided into two kinds, the milder, and the more drastic.

AMONG the more mild, I may mention the Triosteum perfoliatum, sometimes called Bastard-Ipecacuanha. This, when given in very large doses, sometimes proves emetic; hence the vulgar name. But I find it a good cathartic. The cortex, or bark, of the root is employed. I give it in doses of twenty and thirty grains. On some occasions, it has seemed to operate as a diuretic. But this may have been only an accidental circumstance. Rhubarb sometimes produces the same effect, as has been observed by C. Piso.

NEARLY allied to the Triosteum, I mean in its properties, is the Asclepias decumbens. This is one of our most beautiful and common plants. It has received many vulgar names, such as Pleurisy-root, Flux-root, Butterfly-weed, &c. It has been much celebrated in Virginia, as a remedy in dysentery. I have used it, and I think with advantage. I believe it does good principally by its purgative quality. The dose is from twenty to thirty grains of the root in powder. A great deal has been said about the virtue of this vegetable in pleurisy.

THE powder of this Asclepias is escarotic, and has been found useful in restraining fungous flesh in ulcers. I believe this, and not the Poke, as has been supposed, is the plant which is employed by our southern Indians in cases of venereal chancre.

THE dried fruit of our Papaw, or Custard-apple, the Annona triloba of Linnæus, is likewise purgative. I can say nothing of it from my own experience.

I KNOW nothing, from experience, of the *Mechameck*, or Wild-Rhubarb, of some of our Indians. It is, certainly, a species of Convolvulus, or Bind-weed, and I believe the Convolvulus panduratus, which in Virginia is called "wild potatoe." Its name Wild-Rhubarb, implies that it is a purgative. An extract but little, if any thing inferior to the Scammony of the shops, has been procured from one of our species of Convolvulus. One must have a good deal of *medical faith* to believe what Catesby has said concerning the remarkable power of the Convolvulus purpureus, or Purple-Bindweed.*

MORE active than any of the native purgatives which I have mentioned is the Podophyllum peltatum of Linnæus. This is a very common plant through the whole of the United-States, and in other parts of North-America. It is known by a variety of names, such as May-apple, Mandrake, Ipecacuanha, Wild-lemons, &c. The fruit is esculent, and by many persons is thought delicious. The leaves are poisonous.—It is the root which is used in practice. In doses of twenty grains, it is an excellent cathartic. It has some advantages over the rhubarb and jallap. It is most advantageously used in combination with calomel, or the crystals of tartar. I have heard much of the virtues of an extract prepared of this root; but have never used it.

THERE is a plant which was thought by Linnæus to be a species of the same genus. He called it Podophyllum diphyllum. I have shown, that it is a new genus.* I have not been able to collect a sufficient quantity of this to ascertain its powers; but, judging by the taste and smell, which it must be confessed are sometimes fallacious tests, I suspect its root possesses the virtues of the May-Apple, or Podophyllum peltatum.

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* The Natural History of Carolina, &c. Vol. i. p. 35.

THE Cassia Marilandica, one of our finest plants, belongs to the same genus as the senna of the shops. The American species possesses nearly the same virtues as the eastern species. It is used as a purgative in different parts of the United-States.

AN extract prepared from the inner bark of the Juglans cinerea, or Butternut-Walnut, has long been used as a purgative in the United-States. It is a valuable medicine. As it is often, however, very carelessly prepared by the country-people, it has gone into some kind of neglect. It ought to be prepared by the better informed apothecaries, and have a place in the Pharmacopœia of this country, WHEN SUCH A DESIDERATUM SHALL BE SUPPLIED. The dose of this extract is from ten to thirty grains. I have thought it possesses something of an anodyne property.

I HAVE been told, that some of our Indians use as a cathartic a decoction of the bark of the root of the Dirca palustris, or Leather-wood, already mentioned to you. Of this property of the Dirca I know nothing farther.

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* See Transactions of the American Philosophical Society. Vol. III. No. XLI.

THE decoction or powder of the root of the Polygala Senega, or Seneca Snake-root, is also a purgative. Dr. Cullen, indeed, thinks its purgative is its most striking property, and therefore he arranges it under his head of cathartics.*

SOME of our native species of Iris, or Flag, are powerful cathartics. Such are the Iris versicolor and the Iris verna. They are both used by our southern Indians.† I can say nothing certain concerning the dose of these vegetables. It is doubtless small, for they are very active plants. Several of the European species of Iris are irritating cathartics.

A SPECIES of Croton, or perhaps of Stillingia, is used in the southern states, as a cathartic. It enters into the composition of a medicine which has acquired much celebrity in the cure of that hideous disease the Frambæsia, or Yaws. This plant grows

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* "I have put it into the catalogue of purgatives, as this is the only operation of it that is constantly very evident; and perhaps all its other virtues depend upon this." A Treatise of the Materia Medica. Vol. II. p. 532. Edinburgh: 1789, quarto.

† Mr. William Bartram.

spontaneously on the dry, high lands of Carolina, Georgia, and Florida. It is called Yaw-weed, and Cock-up-Hat. The Stillingia sylvatica, perhaps the very plant I have been speaking of, is said to be a specific in the venereal disease.*

SECT. VIII. DIURETICS.

DIURETICS have so long been employed with benefit, in the treatment of dropsies, that it becomes a matter of consequence to increase the number of the medicines of this class, and to learn how to exhibit, with more advantage, those which are already known. I do not mean by this observation to assert, that dropsies cannot be cured without the use of diuretic medicines. On the contrary, I am persuaded that they can, and often are, especially when the dropsy depends upon fever, or is connected with it. But in the management of all kinds of dropsies, it is often necessary to have recourse to the use of diuretics, and I believe that some of the worst forms of this disease, such as hydrothorax, are most effectually cured by these medicines. The Digitalis purpurea, so much and so justly celebrated at present, is not, to my knowledge, a native of any part of

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* Bernard Romans says, the Jallap grows wild near Pensacola, in Florida.

America.* But we have several native diuretics, which deserve the attention of our physicians. Such are the Seneca-Snake-root, the Lobelia siphilitica, the Serratula spicata, the Cassena, and others.

THE first of these, the Polygala Senega of the botanists, along with its diuretic, possesses an emetic, cathartic, expectorant, salivating, and diaphoretic power. I have already hinted at its salivating and cathartic operation. As a diuretic, it has been employed, and found useful, in dropsy, by Tennent, Bouvart, and other writers. I am informed that it has lately been used, with great success, in the treatment of the cynanche trachealis, or croup, by Dr. Archer of Maryland. He uses a strong decoction of the root, which operates as an emetic, cathartic, and expectorant.† This medicine sometimes operates so powerfully as a sudorific, that I have been assured it has been known to remove portions of the mucous body, or rete mucosum, from the skin of blacks who have used it. I do not vouch for the truth of this fact: but I must confess that to me the circumstance does not seem improbable. Our Indians use a decoction of this root in syphilis. I have no confidence in the powers which have been ascribed to the Seneca, in curing the bite of the rattle-snake. Besides the Polygala Senega, we have several other native species of this genus. I do not know how far they possess the powers which have been ascribed to the Seneca itself. It is probable that they only differ in degree. Kiernander, a long time ago, remarked that the Polygala vulgaris, which grows spontaneously in Europe, possesses, though in a less eminent degree, the virtues of the celebrated American species.*

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* This plant, however, bears extremely well the open ground of Pennsylvania.

† There is a species, or rather variety, of croup, which I have sometimes called the Bronchial Hives. In this there does not appear to be any reason to suspect the existence of a preternatural membrane in the trachea: but the disease depends upon the presence of large quantities of mucus, which exists in a loose state in the ramifications of the trachea. I believe this species is much more common than the other, which might be called Cynanche trachealis coriacea. In the bronchial hives, I have found strong coffee of evident use: but the disease often requires a much more active treatment. The Seneca should have a trial.

THE Lobelia siphilitica is also considerably diuretic. This plant was purchased from the northern Indians, by the late Sir William Johnson, as a remedy in the venereal disease: hence its specific name, siphilitica. I do not believe, after paying some attention to the subject, that this plant has cured confirmed syphilis. I know that the Indians, even those who are best acquainted with the plant, are glad to have an opportunity of applying to the whites for relief, when they have the disease. They certainly do not trust the cure entirely to the Lobelia. They use the bark of the wild cherry (Prunus Virginiana), the root of the May-apple (Podophyllum peltatum), and many other plants.* I believe, however, that the Lobelia has been of service in the disease. In gonorrhea it has certainly performed a cure; but the tendency of the constitution, unaided by medicines, to get rid of this complaint, is well known. I may here observe, that gonorrhea appears to be much more common among the Indians than syphilis. The Lobelia seems to operate chiefly by its diuretic quality. From their ignorance of botany, many persons in the western country have been using a plant, which they call Lobelia, in the same complaints. I have received specimens of the plant under the name of Lobelia. It proves to be the Serratula spicata, or Spiked Saw-wort. There is good reason to believe, that it has been found useful, not only in venereal complaints, but also in cases of nephritis calculosa, or gravel. Thus ignorance sometimes leads to knowledge. This supposed Lobelia is a powerful diuretic. The Indians sometimes drink the decoction of it so strong that it occasions gleets.† It is the root of the plant which is commonly employed, but the flowers and the leaves may also be used.

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* See his paper, entitled Radix Senega, in the second volume of the Amoenitates Academicæ.

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* I do not believe that the disease of syphilis was known among the North-American Indians before they became acquainted with the whites. Mr. John Heckewelder informs me, that the Indians speak of it as a foreign disease communicated by the whites.

† They cure these gleets by eating turpentine, as I am informed by Colonel Winthrop Sargent. An old Indian assured this gentleman, that

An infusion of another species of Lobelia, I believe the Lobelia inflata, has been found very useful in the leucorrhoea, or whites. It is a lactescent, and very active plant. I do not know that this acts as a diuretic, and it would have been more proper to have mentioned the plant under the head of stimulants.

The Cassena is a species of Ilex, or Holly. It is the Ilex vomitoria of Aiton, and is a native of Carolina, West-Florida, &c. It has been called South-Sea-tea, or Evergreen Cassine. It is thought to be one of the most powerful diuretics hitherto discovered. It is held in great esteem among the southern Indians. They toast the leaves and make a decoction of them. It is the men alone that are

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a decoction of this Serratula cures syphilis in all its forms. Dr. Allison, one of the army-physicians, has an high opinion of the plant, in this disease. I am told Dr. Bedford, of Pittsburg, has found it an efficacious medicine in the gravel. It certainly ought to have a fair trial in these diseases. The late Major Jonathan Hart assured me, that the Indians northwest of the Ohio could not cure confirmed syphilis. He said the Lobelia (I suppose the Serratula spicata) had been of service in slight cases: but he was persuaded that the Indians would fall victims to the general complaint, if they were to trust wholly to their own remedies. A Mr. Wilson, who is well acquainted with the Indians, particularly the Delawares and Shawneese, most confidently asserts, that they cannot cure the venereal disease, "when it gets into the blood;" but that they can cure the gonorrhea. He also said, they can remove the venereal disease for a time, but "that it will break out again."

permitted to drink this decoction, which is called Black Drink.

The Medeola Virginica grows plentifully in the vicinity of this city, and in almost every other part of the United-States. Its root is white, and tastes a good deal like the cucumber, which has given the plant the name of Cucumber-root. I am told that this root is diuretic, and has cured dropsies. The sensible qualities of the plant do not promise much; but this does not prove that it is not an useful medicine.

SECT. IX. ANTHELMINTICS.

OF the class of medicines called ANTHELMINTICS, or destroyers and expellers of worms, we have several which are entitled to your notice. One of the most celebrated of these is the Carolina Pink-root, the Spigelia Marilandica of Linnæus. This is a very common plant in our southern states. It is a valuable medicine, as has been demonstrated by the physicians of Europe and of this country. It is commonly given in the form of an infusion, or tea; but I prefer the exhibition of it in powder. It has been accused of occasioning, for a short time, a disagreeable affection of the eyes. But this effect may often be prevented by combining with the Spigelia some of the common Virginia Snake-root. The

Cheerake-Indians have so high an opinion of this plant, that it would sometimes be dangerous for a person to be detected in digging it up, to carry it out of the country. The whites learned the anthelmintic powers of this vegetable from the Indians. The Spigelia is said to possess other valuable properties. Infused in wine, it has been found an useful medicine in intermittent fevers. But I can say nothing particular concerning the precise mode of administering it in this case.

THE Chenopodium anthelminticum grows plentifully in the United-States. It is commonly called Worm-seed. The whole plant has a most powerful smell, of which it is very retentive. The taste is bitter, with a good deal of aromatic acrimony.

THE root of the May-apple (Podophyllum peltatum), which I have mentioned to you under the head of cathartics, has often been found to operate as an anthelmintic. It is used as such by the Cheerake, and other southern Indians. Whether it operates by its cathartic quality exclusively, or partly by some other quality, deleterious to the worms, I cannot say. The whites learned from the Indians the anthelmintic power of this plant.*

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* The best time for gathering the may-apple, for medical purposes, is the autumn, when the leaves have turned yellow, and are about falling off. The Indians dry it in the shade, and powder it for use.

THE Helleborus fœtidus, or Stinking Hellebore, has been mentioned as a powerful anthelmintic, by Bisset, and other European writers. It has been used in this country, and has been found very efficacious. It is supposed to have been the worm-medicine of a Dr. Witt, who acquired much reputation by the use of it.*

THE Cheerake use a decoction of the root of the beautiful Lobelia Cardinalis, or Cardinal-Flower, as a remedy against worms. I have already mentioned the diuretic quality of another species of this genus, the Lobelia siphilitica.

THE seeds of the Common Tobacco (Nicotiana Tabacum) have also been found useful as an anthelmintic.

THE Silene Virginica, or Ground-Pink, as it is called in some parts of our country, is another native anthelmintic. A decoction of the root is used, and is said to have been found a very efficacious remedy.†

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* I am indebted to Dr. Adam Kuhn for this information. He says that Witt used the powder of the leaves in combination with the ethiops mineral.

† From the information of my friend the late Dr. James Greenway, of Virginia.

I HAVE not lost all confidence in the anthelmintic powers ascribed to the Polypodium vulgare, or Male-Fern. I do suppose, however, that too much has been ascribed to this plant. We have several native species of this genus, which it would, at least, be a matter of curiosity to examine. The Polypodium Virginianum grows about this city, and probably possesses the same powers as the European species.

A PLANT, called the "Pride of India," has lately been mentioned as an excellent anthelmintic. The bark of the root has been used as such in South-Carolina. This vegetable, the Melia Azedarach of Linnæus, is not a native of our country.*

I SHALL conclude this account of anthelmintics by observing that the southern Indians dress all their dishes, prepared of the Indian-corn, or maize, (Zea Mays) with a strong lixivium, or lye, of the ashes of bean-stalks and other vegetables, in order to prevent the generation of worms. They are of opinion that this grain nourishes the worms exceedingly. Nor is this opinion peculiar to the Indians.

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* Mr. Andrew Michaux informed me, that in Persia, where this plant grows spontaneously, the pulp which invests the stone of the seed is pounded with tallow, and used as an "antisphoric," in cases of tinea capitis in children.

I HAVE thus, Gentlemen, endeavored to present you with a specimen, or rather rude outline, of an Essay towards a Materia Medica of the United-States. My object has been a collection of facts. I could have wished for more leisure to have pursued the subject: but that leisure I do not possess. I hope, however, that with all its imperfections, I have presented you with a sketch which will not prove unacceptable to you. I have opened a path which deserves to be trod by you all.

THE man who discovers one valuable new medicine is a more important benefactor to his species than Alexander, Cæsar, or an hundred other conquerors. Even his glory, in the estimation of a truly civilized age, will be greater, and more lasting, than that of these admired ravagers of the world. I will venture to go farther. All the splendid discoveries of Newton are not of so much real utility to the world as the discovery of the Peruvian bark, or of the powers of opium and mercury in the cure of certain diseases. If the distance of time, or the darkness of history, did not prevent us from ascertaining who first discovered the properties of the Poppy, that "sweet oblivious antidote" for alleviating pain, and for soothing, while the memory remains, those rooted sorrows which disturb our happiness; if we could tell who first discovered the mighty strength of Mercury in strangling the hydra of pleasures and of generation; if we could even ascertain who was the native of Peru, that first experienced and revealed to his countrymen the powers of the Bark in curing intermittent fevers; would not the civilized nations of mankind, with one accord, concur in erecting durable monuments of granite and of brass to such benefactors of the species? Would not even the savage, who wants not a sense of benefits conferred upon him, be seen to form the tumulus of stones, or to raise the green sod, the only monuments his humble condition would admit of his erecting? And may we not yet look for the discovery of medicines as important to mankind as opium, the bark, and mercury?

For this purpose, the discovery of new and valuable medicines, your situation, Gentlemen, (I address myself at present, more especially to the younger part of my audience); for this purpose, your situation is peculiarly happy. In the pursuit of one of the most dignified and most useful of all the sciences, you are placed in an extensive country, the productions of which have never been investigated with accuracy, or with zeal. From this school, I will venture to call it the *punctum saliens* of the science of our country, you are to spread yourselves over the happiest and one of the fairest portions of the world. In whatever part of this vast continent you may be placed, you will find an abundant field of new and interesting objects to reap in. The volume of nature lies before you: it has hardly yet been opened: it has never been perused. But by your assistance, the knowledge of the natural productions of our country may be greatly extended, and travellers shall then no longer upbraid us with an utter ignorance of the treasures which an all-benevolent Providence has so largely bestowed upon us. May I not flatter myself that among the number of those whom I am now addressing, there are some of you for whom medical discoveries of importance are reserved? discoveries which would add a lustre to your names, whilst they would ensure to you that which is much more to be desired, in this mixed scene of affairs, an happiness that is imbosomed in the happiness of one's country, and the world.

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APPENDIX,

CONTAINING

ILLUSTRATIONS AND ADDITIONS.

PAGE 14. "I am well acquainted with a physician," &c. The room in which the flowers of the Magnolia glauca produced the effects here mentioned, was not a small one, and was well aired. It was in the month of June.

I ought to have observed, under the head of Tonics, that the Menyanthes trifoliata, or Marsh-Trefoil and Bog-bean of the English, is a native of our country. It grows spontaneously in Pennsylvania. This is certainly an active plant, and if we can depend upon the half of what has been said of its virtues, it deserves a place in the Pharmacopœia of every country.

Page 18. Dr. Samuel Cooper. See his valuable Inaugural Dissertation on the Properties and Effects of the Datura Stramonium, &c. Philadelphia: 1797.

Page 18. Cicuta venenosa. In Virginia, this plant is called Wild-Carrot, Wild-Parsnip, Fever-Root, and Mock-Eel-root. See Transactions of the American Philosophical Society. Vol. iii. No. xxix.

Page 19. Kalmia latifolia. In South-Carolina, this beautiful shrub is called "Calico-Tree."

Pages 19, 20. "A decoction of the Andromeda Mariana has been found useful as a wash, in a disagreeable ulceration of the feet, which is not uncommon among the slaves, &c. in the southern states." This complaint is very common, particularly among the negroes and the poorer sort of white people, in Carolina, Georgia, &c. It is called "Toe-Itch and Ground-Itch." It is a kind of ulcerous excoriation between the toes, sometimes extending as high as the instep, and is attended with most intolerable itching. It is probably, in a great measure, the consequence of inattention to cleanliness. Is it occasioned by particular insects? Some persons, with whom I have conversed on the subject, are of opinion, that it is owing to the great warmth of the waters to the southward, in which the inhabitants are accustomed to wade a great deal. The disease is sometimes seen in Pennsylvania. Besides the Andromeda Mariana, or Broad-leaved Moor-wort, a decoction of the leaves of the Kalmia latifolia is used for the cure of this complaint. The decoction of the leaves of both these plants is used. They are both called "Wicke" to the southward.

Page 21. "I knew a woman," &c. She was a stout, and seemingly very hearty, woman. She informed me, that a lady of her acquaintance was affected in the same way by this tea. I could not learn whether the flowers of the Sassafras produced a similar effect.

Page 24. Rhus, or Sumac. "It is said that the bark of one species (but I cannot tell you what species) has been found useful in intermittents." Perhaps it is the bark of the Rhus glabrum, or Smooth Pennsylvania Sumac. In some parts of our country, this species is called "Indian Salt." Was it used as a condiment to their food by the Indians? The berries of this species are used as a mordant, or fixer for the red colour with which they die their porcupine quills. They use other mordants for the same purpose. The juice of the Upland-Sumac (Rhus glabrum?) is said to be excellent for removing warts, and also tetters. It is applied to the affected parts.

Page 27. "The expressed juice of the fresh leaves" of the Asarum Canadense, "is a powerful emetic." I should have observed that the leaves are errhine. "Asari canadensis radices suaveolentes in petio vino fermentanti immersæ, liquorem gratiorem reddunt." Cornutus, as quoted by Schoepf, p. 73.

Page 30. Asclepias decumbens.—The Asclepias decumbens, and the Asclepias tuberosa, of Linnæus, appear to me to be merely varieties of the same species. Dr. Schoepf (page 160) mentions a plant which he says is called in Maryland, Butterfly-root, and Pleurisy-root. He says he has not seen the plant; but that the name Butterfly-root seems to shew that it belongs to the class of Diadelphia. I suspect this plant is no other than the Asclepias decumbens. It is called Butterfly-weed, &c. because its flowers are often visited by the butterflies.

Page 35. Polygala Senega. If this plant has been found so useful in pleurisy as it is said to have been, by Tennent, and other writers, I cannot suppose it has been in genuine inflammatory pleurisy, unless previously to the exhibition of the medicine, the lancet has been liberally used. In the pleurisy, as it is called, which prevails in the low and marshy countries, it is not improbable it has been of real use. This is a true intermittent or remittent, attended with a local pain, either in the side, or in the head. When it is in the head, the disease is called (a ridiculous name) the pleurisy in the head. In either case, it is a complaint in which cordial medicines, and such the Seneca is, have been exhibited with advantage.

Almost an hundred years ago, the Reverend Dr. Cotton Mather mentioned an American plant, called "Partridge-berries," as being excellent for curing dropsy. A decoction of the leaves is to be drank as a tea, for several days. It discharges, he says, a vast quantity of urine, as long as the disease lasts, "after which it may be drank without provoking urine observably. Gouty persons drink it with benefit."* I take the plant mentioned by Mather, to be the Mitchella repens of Linnæus. This is a very common plant in every part of the United-States. In New-England, it is called Partridge-berry. Catesby has given us a wretched figure of it. I know nothing of the powers of this plant. I could mention some of the superstitious notions of our Indians concerning it.

Page 40. Chenopodium anthelminticum. This is also called Jerusalem-oak. It is the seeds that are used.

*The Philosophical Transactions, Abridged. Vol. V. Part ii. p. 160.

THE END.

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COLLECTIONS FOR AN ESSAY TOWARDS A MATERIA MEDICA OF THE UNITED-STATES.

By BENJAMIN SMITH BARTON, M. D.

PROFESSOR OF MATERIA MEDICA, NATURAL HISTORY, AND BOTANY,
IN THE UNIVERSITY OF PENNSYLVANIA.

PART SECOND.

——— hanc etiam, Mæcenas, aspice partem.

PHILADELPHIA:
PRINTED, FOR THE AUTHOR,
BY A. AND G. WAY.
....
1804.

DISTRICT OF PENNSYLVANIA. TO WIT:

BE it remembered, that on the fourteenth day of February, in the twenty-eighth year of the Independence of the United States of America, Benjamin Smith Barton, of the said District, M. D. hath deposited in this office, the Title of a Book, the right whereof he claims as Proprietor, in the words following, to wit:

"Collections for an Essay towards a Materia Medica of the
" United States. By Benjamin Smith Barton, M. D. Professor of
" Materia Medica, Natural History, and Botany, in the University
" of Pennsylvania. Part Second.

"—— **Hanc etiam, Mæcenas, aspice partem.**"

In conformity to the Act of the Congress of the United States, entituled "An Act for the Encouragement of Learning, by securing the Copies of Maps, Charts and Books, to the Authors and Proprietors, of such Copies, during the times therein mentioned, 'And also to the Act, entituled "An Act, Supplementary to an Act entituled "An Act for the encouragement of Learning, by securing the Copies of Maps, Charts and Books, to the Authors and Proprietors of such Copies, during the times therein mentioned, and extending the Benefits thereof to the arts of Designing, Engraving and Etching Historical and other Prints."

D. CALDWELL,
Clerk of the District of Pennsylvania.

TO

JOHN COAKLEY LETTSOM, M. D.

FELLOW OF THE ROYAL SOCIETY OF LONDON, &c. &c.

DEAR SIR,

YOU have been pleased to express yourself favourably respecting the First Part of this little work. But it was not this circumstance that has led me to inscribe this Second Part to you. My inducements to do this, are of a higher and a different kind.

YOUR attentions to me, during my residence in London, in the year 1787, were those of a kind and affectionate friend, and cannot readily be forgotten. Nor have you withdrawn your attentions, notwithstanding the distance by which we are separated from each other.

SOME public tribute of respect is due from Americans, to one who has so long, and on so many occasions, manifested his attachment to the United-States. The tribute which I now pay is, indeed, a very feeble one: but it is paid in the warmth of feeling friendship.

A LARGE portion of respect is due from the world to those, who devote their fortune and their time to the promotion of science, and the extension of the godlike empire of benevolence. Your enemies will not deny your merits in these respects. Your friends are incapable of disguising or withholding their sentiments, on the subject.

ATTACHED, as you are, to every branch of medical science; sensible, as you must be, of the imperfections of medicine, and ardently anxious for its further improvement, I will flatter myself, that you will peruse, with some satisfaction, these imperfect *Collections*, a mass of mere mishapen materials, out of which, at some future period, a part of a more regular AMERICAN MATERIA MEDICA may be constructed. Whether I shall live to take any part in the building, is extremely doubtful. The edifice is one, however, to which I look forward with an ardent zeal. A belief that I may *possibly* behold it, will serve to stimulate me to new and other labours, in this walk of medical science.

WITH the most sincere wishes for your health and happiness, and for the continuance of your useful labours and exertions, I remain,

My dear Sir,
Your obedient and
Obliged friend,
BENJAMIN SMITH BARTON.

Philadelphia,
February 10*th*, 1804.

PREFACE.

I EXPERIENCE some degree of pleasure in being able to fulfil one of my literary promises. I present to the public, a SECOND PART of my *Collections for an Essay towards a Materia Medica of the United-States.* I am not very anxious about the fate of the work, and therefore, I shall not offer any formal apology for its imperfections. These will be readily perceived by the reader of any experience.

IMPERFECT, however, as is this Second Part, I hope the student of medicine and the young practitioner, for whom principally it is intended, will find it not less interesting than the preceding part. It contains additions to many of the articles which are mentioned in the former portion of the work, besides facts and observations concerning other articles, which are either entirely unnoticed, or merely named, there. Some of the newly named articles have never before been noticed in any work relative to the Materia Medica: such are Myrica cerifera, Prinos verticillatus, Hydrastis Canadensis, Frasera Walteri, &c. How far these are worthy of the attention of physicians, must be left to others to determine.

To render the work somewhat more useful, I have interspersed it with occasional practical remarks. Some of these remarks, I am very ready to allow, are not necessarily introduced into the work. Such are those respecting Arsenic, and Digitalis. But it will be recollected, that I am not in pursuit of anything like a methodical or regularly-digested work: and if any value be attached to the remarks, I shall cheerfully submit to be censured for my want of order and arrangement, in the management of my subject.

The principal, and indeed only, object which I had in view in composing the First Part of this little work, has been, in some measure, accomplished. I WISHED TO TURN THE ATTENTION OF OUR PHYSICIANS TO AN INVESTIGATION OF THE PROPERTIES OF THEIR NATIVE PRODUCTIONS. Already have I had the satisfaction to perceive the useful tendency of my labours. Several of the vegetables which I had mentioned in the *Collections*, have been examined with care and ability, by graduates in the University of Pennsylvania, who have thus put us in possession of a large body of useful information concerning those vegetables. It is unnecessary to mention, in this place, the titles of the dissertations to which I allude. Most of them are referred to in the present publication. Some of these dissertations reflect honour upon their authors; and must evince to the world, that an important branch of natural history and of medicine is making rapid advances among us. It is not one of the least pleasurable circumstances of my life, that I have been, in some degree, instrumental in directing the medical students of the United-States to a few of those objects, which have since solicited their attention.

In the present portion of the *Collections*, I have called the attention of the student to other objects of the American vegetable kingdom, concerning which I am anxious to receive more extensive and more correct information. My various pursuits do not permit me to enter minutely into an investigation of the properties of the articles which I mention. Indeed, I wish it to be understood, that some of these articles have never been employed by myself in practice; and, consequently, that my information concerning them has been derived from the experience of other persons. It is obvious, therefore, that I cannot always vouch for the truth or accuracy of the observations, which I detail, concerning the properties and effects of our vegetables. But neither could I have vouched for their truth and accuracy, even though I had related them from my own experience. For where is the candid physician who will not confess, that he often errs? Where is the physician who will not acknowledge, that in the course of his practice, he has often ascribed effects to medicines, which those medicines did not produce? EXTRAORDINARY (PROVIDED THEY BE SOLITARY OR RARELY OBSERVED) EFFECTS OF MEDICINES, IN THE CURE OF DISEASES, SHOULD BE RECEIVED BY THE PHYSICIAN, WITH NEARLY THE SAME HESITATION WITH WHICH THE PHILOSOPHIC NATURALIST OR HISTORIAN, RECEIVES MIRACLES INTO HIS COLLECTION OF WELL-ASCERTAINED FACTS.

* * * *
* * *
* *
*

THE following observations form a part of one of my Introductory Lectures. I have thought that they might, with some propriety, be introduced in this place.

◆

"IT is a trite observation, that every country possesses remedies that are suited to the cure of its peculiar diseases. The greater number of those who have adopted this opinion, have imagined, that the principal portion of indigenous remedies is to be found among the vegetables of the countries in which the diseases prevail.

"THIS observation, in a limited degree, is undoubtedly well founded. But the universality of the position may, I think, be called in question. Man is subject to many diseases, both of body and of intellect, for the cure of which it would seem to be a part of the scheme of Providence, that he never shall discover remedies. Moreover, man is capable of subsisting, and actually does subsist, in certain portions of the earth, in which hardly a vegetable is seen, or can be made, to grow. Yet, in these situations man is not exempted from diseases: for diseases appear to be as necessarily a part of his essence or nature as the organs and the functions of his body.

"BUT although we are not authorized, from an extensive examination of the subject, to conclude, that every country possesses native remedies, that are the best adapted for the cure of its peculiar diseases, still it must be admitted, that the observation is, in part, well founded. It was remarked by a writer*, who was more distinguished for the vivacity of his wit than for the solidity of his judgement, that the intermittent fever prevailed in Europe, but that the Peruvian bark was found in South-America. This observation was intended as an exception to the general rule which I have mentioned. Perhaps, it was intended to arraign the benevolent order of Providence. But the observation can have no weight with physicians who know, that the intermittent fever is the disease of almost every climate, and that the Peruvian bark is not the only remedy that is capable of subduing this disease.

"WITHOUT any regard, however, to the rule that, in general, the remedies for diseases exist in the native countries of such diseases, it may safely be conjectured, judging from the discoveries which have already been made, in the term of three hundred years, that there are no countries of the world from which there is reason to expect greater or more valuable accessions to the Materia Medica, than the countries of America. The different species of Cinchona, or Peruvian bark, the Quassia, the Simarouba, the Guaiacum, the different kinds of Jallap and of Ipecacuanha, the Polygala Senega, the two species of Spigelia, not to mention many other valuable medicines, are all natives of America; and most of them have not, hitherto, been found in any other portion of the world.

"It has often been said, that the Materia Medica is already crowded with a great number of inert, useless, or pernicious medicines. This I think is strictly true; and it is certainly, high time to banish from the shops many of the medicines, or articles, which they contain. This fullness of the Materia Medica ought not, however, to make us relax in our inquiries into the properties of the vegetables of our own and of other countries. No candid physician will deny, that he often meets with cases in which the choice of active medicines is a matter of consequence. So various are the constitutions of our patients; so infinitely various are the forms under which diseases present themselves, that it becomes absolutely necessary to know, and to possess, a great number of different medicines, even of those which are endowed with a common assemblage of properties.

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* Monsieur De Voltaire.

"I AM not ignorant, that there are some persons, who consider the science of medicine as a science of extreme simplicity; who believe, or affect to believe, that in the treatment of diseases, we have arrived at something like the *ultimatum* of perfection. We are already, say these persons, in possession of all the means that are necessary for the alleviation, or for the cure, of our diseases. It is needless, then, to ransack nature any further.

"IN opposition to such an opinion as this, it will be sufficient to hint at the recent date of the introduction of some of the most important articles of medicine into the Materia Medica; or at the recent date of our acquaintance with the new properties and powers of those which have long been known. The properties of Mercury could hardly be said to be known until the general spread of the venereal disease through Europe, towards the end of the 15th and the beginning of the 16th centuries. Nay not more than half the invaluable powers of this herculean medicine were discovered before the middle of the last century; and I cannot hesitate to believe, that many of its properties are still unknown. The Peruvian bark, the Ipecacuanha, the Jallap, the Tobacco, the Guaiacum, and many others, were not even named to the physicians of the old-world, until several years after the discovery of America, in 1492. Some of the most valuable properties of Opium, such as its use in the treatment of low nervous fevers, were not detected before the middle of the eighteenth century; and of the Digitalis, one of the most common plants of some of the most cultivated countries of Europe, little except the fact of its being an extremely deleterious plant, was ascertained previously to the excellent publication of Dr. Withering. These facts, certainly, show us, that we have no reason for believing, that the list of important articles of the Materia Medica is completed; or that we are fully acquainted with all the properties of those which have been known for hundreds of years. On the contrary, they render it highly probable, that hitherto, we have discovered but a very small part of those vegetable and other remedies, which Providence, in the fullness of his benevolence, has scattered over the earth.

"In conducting our inquiries into the properties of the medicinal vegetables of our country, much useful information may, I am persuaded, be obtained through the medium of our intercourse with the Indians. Let not this observation induce any of you to suppose, that I am of opinion, with many travellers, and with some writers on the Materia Medica, that the savages of North-America are in possession of absolute specifics for all, or for any, of their diseases. I am too much of a skeptic in matters that regard the science of medicine to admit of the existence of any medicines that are strictly entitled to the name of specifics; and my inquiries concerning the diseases and remedies of our Indians have convinced me, that among these people the art of medicine is truly in a shapeless and an embryo state.

"It is, nevertheless, certain that some of the rudest tribes of our continent are acquainted with the *general* medical properties of many of their vegetables. Like the rest of mankind, they are subject to diseases; and like all nations in the savage forms of society, many of their diseases are violent. Nor, notwithstanding what has been repeatedly asserted to the contrary, are the diseases of those North-American tribes with whom we are the best acquainted either simple or few. The diseases of our Indians, even of those tribes who have been the least influenced, or corrupted, by their intercourse with more civilized nations, are numerous, and often present themselves in the mixed or complicated forms which have been supposed to be, in a great measure, confined to nations in the more improved and luxurious stages of society. It is, I believe, a truth, that the medicines of savage and other uncultivated nations are, in general, medicines of an active kind. Thus, if we except that farrago of articles which are employed by our Indians as supposed remedies against the bites of venemous serpents,* we shall find that the Materia Medica of these people contains but few substances as inert as many of those which have a place in our books on this science, and on other parts of medicine. The astringents and tonics, which they employ in the treatment of intermittent fevers, are the barks of some species of Cornus, or Dogwood, such as Cornus florida and Cornus sericea, both of which are found to possess properties very nearly allied to those of the Cinchona, or Peruvian bark: their purgatives are different species of Iris, or Flag, the root of the Podophyllum peltatum, or May-apple; the bark of the Juglans cinerea, or Butter-nut, and some others: their emetics are the Spiræa trifoliata, or Indian Physic; the Euphorbia Ipecacuanha, Sulphat of Iron, or Copperas, and many others: their sudorifics are the active Polygala Senega, or Seneca snake-root, the Aristolochia Serpentaria, or Virginia snake-root, the Eupatorium perfoliatum, or Thorough-wort, the Lobelia siphilitica, &c: their anthelmintics are the Spigelia Marilandica, or Carolina Pink-root, the Lobelia Cardinalis, or Cardinal-Flower, &c.

"From this list, which it would be an easy task to render more extensive and more perfect, it must be obvious, that the Indians of North-America are in possession of a number of active and important remedies. It will not be denied, however, that they do not always apply their remedies with judgment and discernment. But what treasures of medicine may not be expected from a people, who although destitute of the lights of science, have discovered the properties of some of the most inestimable medicines with which we are acquainted? Without mentioning the productions of South-America, let it be recollected, that it is to the rude tribes of the United-States that we are indebted for our knowledge of Polygala Senega, Aristolochia Serpentaria, and Spigelia Marilandica.

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* See Transactions of the American Philosophical Society. Vol. iii. No. xi.

"It is observed by De Pauw, that Botany is the only science that is known to savage nations.* This observation is more just than many others that are to be found in the writings of this singular author. But it would have been still more just, if, instead of Botany, the term Materia Medica had been employed. Savages, in general, know nothing of the sexual differences of vegetables; their classification, &c. circumstances intimately appertaining to the science of Botany.† But a knowledge of the obvious habit or deportment of their plants, and of the general properties of these plants, is, indeed, a very prominent feature in the description of many savage nations: it is, perhaps, more especially a prominent feature in the description of the savage nations of North-America.

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* Recherches Philosophiques sur les Americains, &c. Tome 1.

† If, however, we may depend upon the observations of Dr. Forster, the inhabitants of Otaheite, and other islands in the Southern Pacific Ocean, are "acquainted with the sexual system, especially in the coco-palm." These people have also learned to designate by distinct and often appropriate names, the bracte and various other parts of the plant, in a manner so correct, that it must be acknowledged, that the dawn of Scientific Botany has commenced among them. See observations made during a Voyage round the world, &c. p. 498, 499, 500. London: 1778. 4to.

"But it is only with their general properties that they are acquainted. For the discovery of these the uncultivated reason of man, even the wild instinct of the animal, are often sufficient. It is the province of science; it is the duty of those who attach themselves, with a well-guided ardour, to the amiable pursuits of medical and natural science more especially, to investigate, with a laborious and accurate attention, the whole of the properties of the various natural objects by which they are surrounded. The illiterate Indians of Loxa, in Peru, were not ignorant, that the Peruvian bark cured intermittent fevers: but it was reserved for men of science, aided by the ample experience of many years, to discover the numerous other properties of this important, this indispensible, article of the Materia Medica."

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COLLECTIONS, &c.

SECTION I. ASTRINGENTS.

GERANIUM maculatum.* This is, certainly, a vegetable entitled to the attention of American physicians. In Kentucky, where it is called "Crow-foot," it has been collected for the Tormentil† of the shops. In some of the north-western parts of the United-States, it is known by the name of *Racine a Becquet*, after a person of this name. The western Indians say it is the most effectual of all their remedies for the cure of the venereal disease. I have not, however, been able to learn, in what form or stage of this disease they employ it. I doubt not it would be found very useful, exhibited internally, in cases of old gonorrhoea. In such cases, the internal astringents are too much neglected.

AN aqueous infusion of the root forms an excellent injection in gonorrhoea. In old gonorrhoea, and in gleets, a more saturated infusion may be employed, either alone, or combined with a portion of the sulphat of zinc, or white vitriol.

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* See Collections, &c. Part First. pages 8 & 43.

† Tormentilla erecta of Linnæus.

BOTH the simple sulphat and the oxy-sulphat of iron strike a deep violet colour with the infusion of the root in water.

HEUCHERA Americana*. This is the Heuchera Cortusa of Michaux†, who has unnecessarily changed many of the long-received names of American plants. This Heuchera is one of the articles in the Materia Medica of our Indians. They apply the powdered root to wounds, and ulcers, and cancers.

OF the Pyrola umbellata I have made no mention in the first part of this work. It is a very common North-American plant, and is sometimes called Ground-Holly, but is much better known (at least in New-Jersey and in Pennsylvania) by the name of *Pippsisseva*‡, which is one of its Indian appellations. In the sexual system of Linnæus, it belongs to the same class and order (Decandria monogynia) as the Uva Ursi. It also belongs to the same natural assemblage of plants as the last mentioned vegetable: viz. the order *Bicornes* of Linnæus, and the order *Ericæ* of Mr. de Jussieu. The two plants are, unquestionably, nearly allied to each other in respect to their botanical affinity, as well as in their medical properties.

THE Pyrola is considerably astringent, and the quantity of astringency appears to be nearly the same in the leaves and in the stems. Hitherto, it has not greatly excited the attention of physicians. But I think it is worthy of their notice. A respectable physician, in East-Jersey, informed me, that he had employed this plant, with manifest advantage, in the same cases in which Uva Ursi has been found so useful. This looks very probable: for it would seem, from many facts, that the lithontriptic powers of the Uva Ursi are, in no small degree, owing to the astringent quality of this plant: and, "perhaps, upon the whole (as an eminent practitioner* "has observed), we shall find it no better than other vegetable astringents; some of which have long been used "by the country people, in gravelly complaints, and with "very great advantage: though hitherto unnoticed by "the regular practitioners†."

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* See Part First. Page 9.

† Flora Boreali-Americana, &c. Tom. i. p. 171.

‡ Perhaps, *Phipsesawa*.

THE Pyrola, as I am informed by my pupil Dr. John S. Mitchell, has been used, with good effect, in some cases of intermittents. In one case, its diuretic operation was evident. "The urine discharged was almost "black. It appeared as if a few drops of a solution of "the sulphat of iron had been put into an astringent "infusion‡." This was a solitary occurrence, and one which I am unable to explain.

FOR more ample information concerning this vegetable, I beg leave to refer the reader to Dr. Mitchell's Inaugural *Essay on the Arbutus Uva Ursi, and the Pyrola umbellata and maculata* of Linnæus§. Prefixed to this dissertation, there is a good figure of the Pyrola umbellata.

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* Dr. Withering. See A Systematic Arrangement of British Plants, &c. Vol. II. p. 391. London: 1801.

† I cannot forbear mentioning in this place (at the risk, perhaps, of exposing myself to the ridicule of the mere theorist), that the *nuclei*, or kernels, of the common American Hazlenut (Corylus Americana) have been found very useful in affording relief to several persons labouring under nephritic, and perhaps calculous affections. I mention this fact on the respectable authority of my friend, Dr. Frederick Kuhn, of Lancaster, in Pennsylvania. Do these kernels act solely by virtue of their astringent quality?

‡ Letter to me, dated Sunbury, August 8th, 1803.

§ Philadelphia: 1803.

THE Myrica cerifera, or Candle-berry Myrtle, deserves to be mentioned in this place. This is a common shrub in many of the maritime parts of the United-States, as in New-Jersey, Delaware, &c. This is, unquestionably, a very powerful astringent, and as such has been employed by the country-practitioners of the United-States. A decoction of the bark of the root is employed, sometimes alone, and sometimes in combination with the bark of the root of Persimmon, or with the bark of the Black-Alder, which I am afterwards to mention. The simple or combined decoction of the Myrica has been used, with much advantage, in dropsical affections succeeding to intermittents, particularly in the peninsula of Delaware, where dropsies, in various shapes, are, perhaps, more common than in any other part of North-America, within the same latitudes. The root of the Myrica has likewise been found useful in the treatment of hæmorrhages from the uterus, &c. It was remarked by an old physician,* who had much experience in the use of this vegetable, that it often acted as a gentle purgative.

SEVERAL varieties of the Myrica cerifera are described by the botanists. That of which I have been speaking is distinguished by the circumstances of its having broader leaves, and larger berries, than the others. It is the variety marked β and named *media*, in the *Flora Boreali-Americana* of Michaux.† I cannot, however, assert, that as an astringent, this is to be preferred to the other varieties.

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* Dr. Matthew Wilson.

† Tom. II. p. 228.

THE Myrica Gale, called Sweet-Willow, or Dutch-Myrtle, and also American Bog-Gale, is likewise a native of the United-States. But this, to which useful qualities are ascribed, by Linnæus and other writers, seems less worthy of our notice than the above-mentioned species.

THE Prinos verticillatus* of Linnæus is a very common shrub in many parts of the United-States. It is especially common in the maritime parts of the union, at least as far south as North-Carolina; and is generally found to grow in the greatest perfection in swamps, or marshy places. It is the Prinos Gronovii of Michaux. To the inhabitants of New-Jersey and Pennsylvania, it is well known by the name of Black-Alder. If I do not mistake, however, the same appellation has been bestowed upon another American shrub, the Ilex? Canadensis of Michaux. Care must be taken to distinguish our Prinos from the Swamp-Alder, or Candle-Alder, which is the Betula serrulata of Aiton.

THE bark of the Prinos verticillatus is manifestly astringent. It is, likewise, considerably bitter, and along with these properties there is united a degree of pungency. The berries, which are of a fine red colour, greatly partake of the bitter quality, and if infused in wine or brandy, might be employed, with advantage, in many of those cases in which bitters, in a vinous or spirituous menstruum, are exhibited by physicians. But it is especially the bark of the shrub that seems entitled to our attention.

THIS has long been a popular remedy in different parts of the United-States. But as yet, it has been greatly neglected by the regular physicians, only a few of whom (so far as I can learn) have been in the habit of employing it. This bark possesses the common properties of the vegetable astringent and tonic medicines; and, accordingly, it has been used as a substitute for the Peruvian bark, in intermittents, and in other diseases. It is employed both in substance and in decoction, most commonly, however, in the latter shape. It is supposed to be especially useful in cases of great debility unaccompanied with fever; as a corroborant in anasarcous and other dropsies, and as a tonic in cases of incipient sphacelus, or gangrene. In this last case, it is, unquestionably, a medicine of great efficacy. It is both given internally, and employed externally as a wash. On many occasions, it appears to be more useful than the Peruvian bark. It ought to have a place in the shops, and in the Pharmacopœia of this country, WHEN SUCH A DESIDERATUM SHALL BE SUPPLIED.

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* Marshall calls this Virginian Winter-Berry.

IN making decoctions or infusions, for the different purposes which I have mentioned, the berries are often mixed with the bark.

THE Orobanche Virginiana, or Virginian Broom-rape, is a very common plant in many parts of North-America. Michaux says that it grows from Canada to Georgia. It is generally, if not always, found under the shade of the American Beach-tree (Fagus ferruginea)*. Hence one of its names, in Pennsylvania, viz. "Beach-drops." But it is much more generally known by the name of Cancer-root†.

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* Michaux entirely restricts its habitation to the root of the Beach: "In radice Fagi nec aliæ plantæ." Flora, &c. Tom. II. p. 26.

† See Elements of Botany, &c. Part Third. p. 80.

Every part of this plant is considerably astringent. This astringency is evinced not only by the taste of the plant, but also by subjecting it to chemical examination. The infusion or decoction assumes an ink-like colour, on adding to it a solution of the sulphat of iron, or copperas. But along with the astringency, especially in the recent plant, there is combined a peculiar and extremely nauseous bitterness. Judging by the taste, we should not hesitate to say, that the Cancer-root is a vegetable endued with considerable powers. It must be confessed, however, that these powers are much less obvious in the dried than in the recent vegetable.

Some of the medical powers of this plant have long been known to the people of the United-States. It has been celebrated as a remedy in dysentery. There are, I think, cases of dysentery in which much advantage might be expected from the exhibition of a medicine possessed of the powers of the Cancer-root. But this vegetable has acquired its principal reputation as a remedy in cancerous affections. How far it is entitled to any character in such affections, I am unable to say, having never employed it in a case of genuine cancer. But it is proper to mention, that the Orobanche has been supposed, by many persons, to have formed a part of the celebrated cancer-powder of Dr. Hugh Martin, whose success in the management of many cases of this dreadful disease, has been acknowledged by the regular practitioners of Philadelphia, &c.

As early as 1785, at which time I was a student of medicine, I was informed, by the people inhabiting the western parts of Pennsylvania and Virginia, that this Orobanche formed the principal part, if not the whole, of Martin's powder. It was even said, that Martin, who had passed some time at Fort-Pitt, was known to have collected the plant for the purpose. I believe it to be a fact sufficiently established, that the basis (or perhaps rather the most active part) of Martin's powder was the oxyd of arsenic. This has been shown by a chemical examination of the powder*, and by other circumstances nearly as decisive. Thus comatose affections (such as are known to be induced by arsenic) have been induced by the powder of Martin, even when externally applied in cancerous ulcers. A case of this kind came under the notice of a physician† in Philadelphia. The patient seemed to fall a victim to the application of the medicine.

But the powder of Martin did not consist entirely of the oxyd of arsenic. This is certain. I believe it to be certain also, that he combined with the arsenic, a vegetable matter; and from what has been said, it would seem not entirely improbable, that this vegetable was the Orobanche Virginiana.

It may be said, and it is not impossible, that Martin added the vegetable matter merely to disguise the arsenic, reposing, at the same time, *all* his confidence in the arsenic alone. I think it more probable, however, that the superior efficacy of Martin's powder, and of the powders in the hands of other empirical practitioners, has been, in part, owing to the addition of something to the arsenic. If there be *no* foundation for this suspicion, how has it happened, that in the management of cancers, the empirical practitioners have often succeeded so much better with their medicines than the regular physicians have done? Both use arsenic. Some of the cancer powders, employed by empirics, in Europe, are known to have been composed, in part, of arsenic and a vegetable matter. The celebrated powder of Plumked was made up of arsenic, the root of a species of Ranunculus, or Crow-foot; and sulphur.

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* See Dr. Rush's paper on the subject, in the Transactions of the American Philosophical Society. Vol. II. No. xxvi.

† Dr. Adam Kuhn, from whom I received the fact.

WHATEVER may have been the vegetable which Martin used in combination with arsenic, it is certain, that the powder of the Orobanche, or Cancer-root, has been of great service (in Philadelphia, &c.) externally applied to obstinate ulcers, some of which had resisted the applications that are commonly made use of in such cases. It would be well to try the effects of this vegetable in those dreadful ulcerations (by some writers deemed cancerous), which are too frequently the consequence of the use of mercury, when it has been given in large quantity. Cases of the kind I allude to, are recorded by Dr. Donald Monro, Mr. Adams, in a valuable work*, and other writers. I have had occasion to see some ulcerations of the same kind in Philadelphia. They often refuse to yield to stimulating or to mild applications.

WITH the view to encourage further inquiry into the nature and properties of the Orobanche Virginiana, I may here mention, that one of the European species of this genus, the Orobanche major, or Greater Broom-rape, is a very powerful astringent, and is said to have been found useful, externally applied, in cases of ulcers. This I mention on the respectable authority of Sir John Floyer†. The activity of the European plant may even be inferred from the fact mentioned by Shreber, that cattle do not eat it. We must pay, perhaps, no regard to certain other powers which have been ascribed to it. "Dicunt autem facere, ut taurum vacca appetat*." I have not been able to learn whether the Orobanche Virginiana is eaten by the horned cattle, or other quadrupeds.

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* Observations on Morbid Poisons, Phagedæna, and Cancer, &c. p. 65, &c. London: 1795.

† Pharmacobasanos, or The Touchstone of medicines, &c. p. 159. London: 1687.

SECTION II. TONICS.

I SHALL open this section with a few notices concerning some indigenous Bitter vegetables, which seem well entitled to the attention of physicians. At the same time, I avail myself of an opportunity of observing, that the tonic quality of vegetables does not so much consist in bitterness as some celebrated writers† have imagined. It will not be denied that many of the bitters (even those which have their bitterness unmixed with astringency) are some of the most useful tonics with which we are acquainted. But, it must be allowed, that certain other bitter vegetables have but a feeble claim to the character of tonics. And it would not be a difficult task to show, that some of the most valuable tonics are (strictly speaking) neither bitter nor astringent. It is not easy, therefore, to say, in what the tonic property of medical agents does especially consist. It will hardly be doubted, however, that every tonic exerts a stimulant effect upon the system, though, on many occasions, it may be difficult, or impossible to measure the intensity or degree of the stimulus applied, merely by an attention to the pulse. THE PULSE IS OFTEN A VERY UNCERTAIN OR FALLACIOUS TEST OF THE OPERATION OF STIMULANT AGENTS.

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* Alberti v Haller Historia Stirpium Indigenarum Helvetiæ inchoata. Tom. i. p. 130.

† Dr. Cullen, particularly. See his Treatise of the Materia Medica. Vol. II. p. 55, &c.

THE Zanthorhiza apiifolia* of L'Heritier, or Parsley-leaved Yellow-root, is a native of North and South Carolina, and Georgia. It is a small shrub, which flowers early in the spring. This vegetable has long been known; but it is only within a very few years that it has excited the attention of physicians.

THE bark of the root is intensely bitter; I think more so than the root of Columbo. This bitter property pervades the wood of the root, as well as the bark: but in the former it is, unquestionably, weaker than in the latter. The bark of the stem is also bitter, perhaps but little less so than that of the root. The sensation of bitterness that is left in the mouth, when the bark has been chewed, is very durable and adhesive. It continues, to a considerable degree, even after the mouth has been repeatedly washed with cold water. There does not seem to be combined with the bitterness, any very considerable degree of a foreign acrimony. However, upon holding the bark for some time in the mouth, it evidently communicates to it a sense of pungency, or acrimony. I think there is less of this pungency in the bark of the stem than in that of the root.

THE infusion of the bark of the root, in hot water, had a disagreeable and somewhat virose smell. From this, however, it ought not to be inferred, that the Zanthorhiza is a deleterious plant. A similar smell belongs to many other bitter vegetables, even to some of those which appear, from the experience of many ages, to be entirely innoxious. I am not ignorant, indeed, that a poisonous quality has been supposed to be necessarily attached to every bitter. I cannot help thinking, that this theory has been the result of a very limited view of the subject of bitters, and of their effects. The evil effects of the Portland powder, and other similar articles, in gouty affections, have, I am persuaded, been greatly exaggerated by Dr. Cullen*, and some other writers: and the real bad effects of these articles must, perhaps, be ascribed to the long-continued repetition of a stimulant powder, by which the energies of the system are wasted, and irregularities occasioned in the circulation of the blood.

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* Zanthorhiza simplicissima of Marshall, and Zanthorhiza tinctoria of Woodhouse. The specific named *apiifolia* should be preferred.

THE Zanthorhiza, so far as we are enabled to investigate its properties, appears to be one of the most pure and unmixed bitters. The addition of the sulphat of iron to an infusion of the bark of the root in boiling water, did not produce the least perceptible change in the colour of the infusion, even when the two articles were suffered to stand for a considerable time, after the addition. In this respect, as well as in others, it appears to make a very near approach to the Columbo. But I am inclined to think, that the Zanthorhiza is the least pure of the two†.

To the saliva, the bark, when it is chewed, communicates the most beautiful yellow colour. The infusion in hot water is also very fine. If its colour could be fixed, the Zanthorhiza would be one of the most important of all the yellow *plantæ tinctoriæ* with which we are acquainted.

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* A Treatise of the Materia Medica. Vol. II. p. 64, 65, 66.

† See Elements of Botany, &c. Explanation of the Plates. Page 26.

HITHERTO, the Zanthorhiza has been but little employed in practice. Some experiments have, however, been made with it*, and these are calculated to show, that it may be advantageously employed, and that it ought to have a place in the shops. Although less pure than Columbo, I believe it is, in certain cases, to be preferred to that celebrated bitter. Professor Woodhouse, who seems to have paid more attention to this vegetable than any other person, has used it, with very good effect, in several of those cases in which the bitter medicines are proper.

FOR a correct representation of the Zanthorhiza, see the *Medical Repository*, already referred to, and also my *Elements of Botany* †.

IN the First Part of these *Collections* ‡, I have made mention of the Hydrastis Canadensis, commonly called "Yellow-root." This is a very common vegetable in various parts of the United-States; particularly in the rich soil adjacent to the Ohio and its branches, in the western parts of Pennsylvania and Virginia; and in Kentucky. The root of this plant is a very powerful bitter: perhaps not less so than that of the Zanthorhiza. To the taste, however, it is unquestionably more pungent than the Zanthorhiza. When held between the lips, it even excites a very considerable sense of pungent heat. The dried root has a strong and virose smell, very similar to that of the Zanthorhiza, but stronger. The infusion in hot water, smells very like the infusion of Zanthorhiza. The two infusions taste a good deal alike.

* See Medical Repository. Vol. V. No. II.

† Plate XII.

‡ Page 9. See, also, Elements of Botany, &c. Part Third, p. 70.

On adding a solution of the sulphat of iron to an infusion of the root of the Hydrastis, I was not able to discover the least indication of astringency. This further shows the affinity of the two plants to each other. I may add, that although they do not both belong to the same artificial subdivision in the sexual system, they are both near relations in a family of Nature's making. They belong to De Jussieu's order *Ranunculaceæ*, which may be considered as a pretty natural assortment of vegetables.

The Hydrastis is a popular remedy in some parts of the United-States. A spirituous infusion of the root is employed as a tonic bitter, in the western parts of Pennsylvania, &c. and there can be little doubt, that both in this and in other shapes, our medicine may be used with much advantage. An infusion of the root, in cold water, is also employed as a wash, in inflammations of the eyes. In these cases, it is well known, that some of the bitter medicines, such as ox-gall, fish-gall, and others, have long maintained some character; and some of them, I believe, are entitled to the praises which have been bestowed upon them.

The root of the Hydrastis supplies us with one of the most brilliant yellow colours, with which we are acquainted. When it shall be subjected to proper experiments, I doubt not, it will be found a most valuable die-plant, and well worthy of a place in the manufacturing houses.

The Gentiana lutea, or common Gentian of the shops, is said to be a native of the United-States*. This, perhaps, is doubtful. But it is certain, that several of the indigenous species of this genus are intense and pretty pure bitters, but little, if at all, inferior to the species just mentioned*.

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* Kalm.

THE Gentiana Centaurium†, or Lesser Centory, is found native within the limits of the United-States. This, however, is not the plant which is called Centory, or "Centry," in Philadelphia, &c., where it is so commonly employed both by physicians, and as a domestic remedy in almost every family.

THE Centory to which I allude is the Chironia angularis of Linnæus. This is a beautiful annual plant, and grows abundantly in many parts of the United-States, as in New-York, Pennsylvania, Virginia, &c. Every part of the plant is intensely bitter, in which respect it differs from the Gentiana Centaurium, the blossoms of which are nearly insipid‡. In other respects, it is closely allied to the Lesser Centory, the properties of which are well known, and established by the experience of physicians, for many hundred years. In no respect, that I can perceive, is the Chironia inferior, as a bitter, to the Centaurium. As a much more common plant than this latter, it may, without any injury to our patients, supersede its use in the practice of American physicians, most of whom, if I do not mistake, have supposed, while they were employing the Chironica angularis, that they were using the Centaurium, of the European writers on the Materia Medica. The Chironia is mentioned by Dr. Schoepf, who speaks of it as aromatic and bitter, and mentions the infusion as being useful in fevers*. Indeed, I believe that no bitter has been more generally prescribed in the United-States, in febrile and other affections, than this common American plant, especially since the memorable year 1793, when it was much employed in certain stages of yellow-fever; and in which I believe it was very often used with much benefit.

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* See Collections, &c. Part First, page 15.

† It is the Chironia Centaurium of Curtis, Withering, Smith, and other botanists.

‡ Lewis.

THE Frasera Caroliniensis of Walter† (Frasera Walteri of Michaux‡) is nearly allied, in botanical habit, to the genus Gentiana. This plant, which is a native of the states of New-York, Carolina, &c., is furnished with a large tuberous root, of a yellow colour, which promises to be little inferior as a bitter, to the Gentian of the shops, and for which, I suspect, it has sometimes been mistaken.

I CANNOT conclude this part of the subject of the Tonics, without observing, that the countries of the United-States are so rich in bitter vegetables, that there can be no *necessity* for having recourse to the foreign articles of this class; especially when such articles are only to be procured at a high price: a circumstance which not unfrequently becomes a source of the adulteration of medicines, in this and in other countries.

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* Materia Medica Americana, &c. p. 27. Schoepf calls the plant, Wild-Succory.

† Flora Caroliniana, &c. p. 87, 88.

‡ Flora Boreali-Americana, &c. Tom. i. p. 96, 97.

IN the First Part of this work, I made some mention of two American species of Cornel, or Dog-wood, the Cornus florida and Cornus sericea*. Since the publication of that part, these two vegetables have engaged the attention of an ingenious graduate in the university of Pennsylvania, Dr. John M. Walker, to whom we are indebted for much interesting information concerning them†. An analysis of the dissertation would not, I presume, be uninteresting to my readers. But I cannot undertake the task in this place. I think it a duty, however, to mention some of the author's experiments and observations.

THE taste of the barks of the two Cornels, and that of the Peruvian bark, is nearly similar, "though some-"what more bitter and astringent in the Corni than the "bark: the former when retained in the mouth some-"time, only impart to the tongue these two tastes, along "with a pleasant warmth; whereas when the latter is "retained the same length of time, along with this "bitterness and astringency, it imparts an indescribable "taste, which will be easily recognized by every one "who has taken the bark."

DR. WALKER'S experiments show, "that the Cornus "florida and sericea, and the Peruvian bark, possess "the same ingredients, that is gum, mucilage, and ex-"tract, which last contains the tannin and gallic acid, "though in different proportions. The Florida pos-"sesses most of the gum, mucilage, and extract; the

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* See pages 11, 12, 45.

† An Experimental Inquiry into the similarity in virtue between the Cornus Florida and Sericea, and the Cinchona officinalis of Linnæus, &c. &c. Philadephia: 1803.

"Sericea the next, which appears to be an intermediate "between the Florida and Peruvian Bark; while the "latter possesses most of the resin. Their virtues ap- "pear equally similar in their residence. The extract "and resin possess all their active virtues. The extract "appears to possess all their tonic power. The resin, "when perfectly separated from the extract appears to "be purely stimulant*."

OUR author has established the stimulant power of the two Cornels, by actual experiments upon the healthy system. By the use of these medicines, the pulse was often rendered fuller and stronger, and always quicker†.

THE bark of the Cornus sericea forms a beautiful tincture with proof spirits. This is deserving of a place in the shops, as are, also the powdered barks of both species.

I CAN add but little from my own experience, concerning the application of these two species of Cornus to the cure of diseases. I believe, however, that it may, with entire safety, be asserted, that as yet we have not discovered within the limits of the United-States, any vegetables which have been found so effectually to answer the purpose of the Peruvian bark, in the management of intermittent fevers, as the Cornus florida and Cornus sericea.

IN an intermittent fever, which prevailed in West-New-Jersey, about twenty-four years ago, the bark of the Cornus florida was found more useful than the Peruvian bark. It was used in the shape of a decoction*. I must candidly confess, however, that I have heard of more instances of the failure of this Cornel than of the Peruvian bark. But has any vegetable so completely prevented the recurrence of the paroxysms of intermittents as the last mentioned one? In the mineral kingdom, indeed, we have discovered an inestimable substitute for the bark: I mean Arsenic. This, particularly I think, when it is given in substance†, will more certainly cure the intermittent than any vegetable yet known, the Peruvian bark excepted. But I am inclined to think, that relapses are more common after the employment of arsenic than after that of the bark. BESIDES, ARSENIC CANNOT ALWAYS BE USED WITH ENTIRE SAFETY. In illustration of this position, I may here observe, that I myself have seen three cases of very general oedema of the face and limbs (especially the former) evidently induced by arsenic. Two of the subjects were children, and the third an adult. They all recovered, without experiencing any other inconvenience from the medicine. I have also seen a case of *temporary* paralysis (or perhaps rather extreme debility) of the limbs induced by the medicine, in a patient labouring under an obstinate intermittent. These notices may, possibly, be of some use to the very young and inexperienced practitioner, for whom principally they are thus candidly mentioned.

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* An Experimental Inquiry, &c. page 29.

† Ibid. page 46.

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* From the information of my learned friend, the Reverend Dr. Nicholas Collin, of Philadelphia.

† I have, for several years, employed the oxyd of arsenic in substance, in preference to Dr. Fowler's solution. I think it a much more certain medicine than the solution. I commonly give it in combination with opium. One grain of the arsenic is united to four or eight grains of opium, and made into a mass with conserve of roses, or honey, or soap. This is divided into sixteen pills, of which I direct the patient (an adult) to take two or three at different periods, in the course of the day and night, *especially during the apyrexia*. Such are the powers of this medicine, that two grains of it are often sufficient to cure an intermittent, that has continued for weeks! Sometimes I use larger doses: but in a majority of the cases that have come under my notice, I have found three sixteenths of a grain of arsenic sufficient for the period of twenty-four hours. As children are, with difficulty, prevailed upon to take the medicine in the shape of a pill, I rub down the arsenic with honey or melasses and water, and sometimes with a portion of gum-arabic. In this form, it is very conveniently given to children, by drops; and the quantity of the mineral, in each dose, may be estimated with considerable accuracy.—In the cure of intermittents, does arsenic operate by virtue of its tonic power?—The Peruvian bark sometimes cures intermittents that have resisted the powers of arsenic.

THE spirituous tincture of the bark of the Cornus sericea, already mentioned, has been advantageously used in the latter stage of diarrhoea, unaccompanied with fever*.

I HAVE already made mention of the Magnolia glauca.† The bark of this tree is celebrated among the Western Indians, as a remedy in rheumatism, and in fevers. The tree grows, in great profusion, upon the river Kanhaway, whither the Indians resort for the purpose of procuring the bark, which they carry off, in great abundance. Employed in the shape of a decoction, it "proves gently cathartic and ultimately sudorific." A cold infusion and a tincture of the bark are much used in intermittents. "In one case of inflammatory rheumatism it "seemed to produce considerable effect and relief, as a "sudorific, after blood-letting had been premised." It is known by the names of Elk-Bark and Indian Bark‡. From the former name, I presume the bark is eaten by the American Elk, or Cervus Wapiti. We know it is eaten by the Beaver: hence one of the English names of this tree, viz. Beaver-tree.

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* From the information of Dr. Amos Gregg, jun.

† See Part First, pages 13, 14.

‡ From the information of my friend, Charles Everett, M. D. of Milton, Albemarle-County, Virginia.

FOR further information concerning the medical and other properties of this vegetable, I refer the reader to Dr. Thomas D. Price's *Inaugural Dissertation on the Magnolia Glauca, or Common White Laurel-tree*[*].

THE bark of the Prunus Virginiana (Cerasus Virginiana of Michaux), which I have mentioned in the First Part of these *Collections*[†], is considerably bitter and astringent. These qualities are accompanied with some aromatic warmth. It has been justly observed, that "there is a great similarity between the flavour of this "bark, and the skin enclosing the kernels of the peach "stones[‡]." This bark also possesses an evident narcotic quality, to which it is highly probable, that some of the useful qualities of the medicine, in certain cases, must be ascribed. It is manifestly stimulant. The bark of the root seems to be more powerful than that of the trunk.

MY own experience with this vegetable has been inconsiderable. The experience and observations of others, however, lead me to believe, that it is a medicine well worthy of the notice of physicians. In some parts of the United-States, the bark has been much employed in intermittents, in which it is said to have been found as efficacious as the Peruvian bark. This I am not willing to believe. But as it is a durable tonic, there is little reason to doubt, independently on actual observations, that it is deserving of attention in this common disease.

THE bark has also been found useful in certain cases of dyspepsia, in consumption of the lungs, and in lum-

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[*] Philadelphia: 1802.

[†] See pages 11 and 34.

[‡] Dr. Morris.

bar abscess, attended with hectic fever, and colliquative sweats. Of its use in this latter case, we have an instance in the *Medical Repository**. The patient made use of a decoction of the bark. It would be easy to mention many other diseases in which this medicine has been advantageously employed.

I HAVE already observed†, that the leaves of this tree are poisonous to certain animals. Dr. Morris has shown, that the distilled water of the leaves is a powerful poison to different species of animals, such as kittens, pigeons, &c. About a tea-spoonful of the water killed a "pigeon fully fledged," in thirty-two minutes. This gentleman was obliged to make his experiments upon the young and imperfectly-expanded leaves of the tree. The adult leaves are doubtless more powerful. Experiments would seem to show, that the deleterious principle of the leaves is of a very volatile nature‡.

UNDER this head of tonics, I may, with some propriety, take notice of the Eupatorium perfoliatum. I am sensible, however, that this vegetable might be more advantageously treated of under several different heads, such as those of Emetics, Sudorifics, &c., than under one individual head. But as a tonic quality is, unquestionably, attached to this plant, and as I am not, in these *Collections*, particularly studious of method, I shall bring together all I have to offer concerning the Eupatorium, under one point of view. Of this very common plant in almost every part of the United-States, I have made

* Vol. v. No. III.

† Part First, page II.

‡ See an Inaugural Dissertation on the Prunus Virginiana, &c. &c. By Charles Morris, of Virginia. Philadelphia: 1802.

mention in the First Part of these *Collections**. It is the Eupatorium connatum of Michaux. Besides the provincial or common English names which have already been mentioned, it is known by the following appellations: viz. Thorough-stem, Cross-wort, Bone-set, and Indian-Sage. The first of these names has been imposed upon it from the peculiar structure of the leaves, which are opposite, and appear as though the stem was thrust through them. It has received the name of Cross-wort, by which it is known in many parts of Virginia, from the position of the leaves, each pair of which (in general) take their origin from opposite sides of the stem, so that they cross each other nearly at right angles. I am more at a loss to refer the word Bone-set to its real origin: but I presume the plant received this name, from the great relief which, on many occasions, it has been known to afford to persons labouring under violent remitting and other fevers, in which the bones are greatly pained. The resemblance of the leaves of this plant to those of the Common Sage (Salvia officinalis) was long ago remarked by the botanists†. Hence the name Indian-Sage, by which this Eupatorium is known in some parts of Pennsylvania. We have seen that it is one of the remedies of the Indians‡.

I HAVE already hinted at the obvious properties of the Eupatorium, and have observed, that it has been used in intermittents, and other fevers§. I am now to remark, in consequence of subsequent inquiries, that the plant has been exhibited, with uncommon advantage, in these affections. In simple intermittents, admitting of distinct intermissions, a decoction of the whole plant, or the leaves in powder, have, on many occasions, proved effectual in preventing the recurrence of paroxysms. I now speak of the medicine, as exhibited during the time of intermission. But the vegetable, especially in the form of a decoction, has often been given during the time of the hot stage, and I am in possession of a large portion of testimony in favour of its efficacy when thus employed. Not only in intermittents, but likewise in remittents, and in the malignant yellow-fever, as it has prevailed in Philadelphia, &c., has our plant been used, with much advantage. When exhibited in the form of a *warm* decoction, it has seemed to prove peculiarly beneficial, especially by exciting a copious perspiration. The effect of the medicine, in inducing this evacuation, constitutes one of its most valuable properties, and has procured to it an appellation (that of the "vegetable antimony") to which, I believe, it is as well entitled as many other vegetables, which might be mentioned. But I greatly doubt if the sudorific effect of this plant, when unassisted by heat, can be compared to that of the Polygala Senega, and several other American plants. It often proves emetic: but this operation, which on many occasions, is not the least useful of its properties, may be prevented by a proper attention to the medicine. In some parts of the United-States, it is exhibited in intermittents, chiefly with a view to its emetic effect.

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* See pages 27, 52, 53.

† Particularly by Plukenet, who thus defines the plant: "Eupatorium Virginianum, *Salviæ* foliis longissimis acuminatis, perfoliatum. Alm. Bot. 140. t. 86. f. 6.

‡ Part First, p. 27, 52, 53.

§ Part First, p. 27, 53.

THE Eupatorium has been used in other cases. It is said to have been found very useful in a peculiar and distressing affection of the herpetic kind, which was formerly very common in Virginia, and there known by the name of the "James-river Ringworm;" because it was especially prevalent among the inhabitants residing upon the upper streams of James-River. This disease was particularly disposed to affect young men. It attacked the thighs, the scrotum, and especially the parts immediately adjacent to the anus. It extended its ravages into the rectum, and perhaps much further. It was at all times, a disgusting and troublesome disease, though it rarely proved mortal.

MR. JEFFERSON* informed me, in 1802, that within the period of his remembrance, this herpes was extremely common in Virginia, and that it had gradually disappeared or become less common, from about the time† that the Warm and Hot Springs, in the county of Bath, in Virginia, had been better known, and more frequented. He ascribed the disappearance of the affection to the use of these waters; the temperature of the former of which is about 98°: that of the latter 106°, of Farenheit's thermometer.

IN this affection, the Eupatorium perfoliatum has often been found very beneficial, as I have been informed by a respectable physician‡ in Virginia. The patient drank a decoction of the plant, and continued the use of it for a considerable time. It sometimes puked: it, no doubt, purged; and, in all probability, it operated as a sudorific. But by what quality it more especially operated, in curing the disease, I am unable to say. The fact may, I believe, be depended upon.

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* The President of the United-States.

† These waters were certainly known at least as early as 1759 or 1760. But I believe they did not begin to be frequented, by any considerable number of persons, until some years after. The James-river Ringworm was very prevalent about the year 1766.

‡ Dr. Thomas Knox, of Culpeper.

IT may, perhaps, serve to increase our confidence in the powers ascribed to the Eupatorium perfoliatum as a remedy for herpes, to observe, that the *Aya-Pana*, which of late has excited so much attention, is a species of this vast family of plants, and that it also has been celebrated as a remedy in certain affections, somewhat allied to herpes*.

I CLOSE this article by observing, that every part of the Eupatorium perfoliatum may be advantageously employed in practice. I believe, from my own observations, that the flowers possess the greatest portion of the activity of the plant; and they ought to be kept in the shops. As a tonic bitter, I deem them superior to the flowers of Camomile, (Anthemis nobilis), for which they might be substituted, on many occasions.

SECTION III. STIMULANTS, OR INCITANTS.

§ I. GENERAL STIMULANTS.

KALMIA latifolia†. The powdered leaves of this vegetable have been used, with much success, in some cases of intermittents‡. A saturated tincture, prepared from the leaves with a proof spirit, is an active medicine, and perhaps worthy of a place in the shops*. For some interesting information concerning the powers of this species of Kalmia, and also those of Kalmia angustifolia, or Narrow-leaved Kalmia, commonly called Lambkill, &c., I beg leave to refer the reader to Dr. George G. Thomas's *Inaugural Dissertation* concerning these plants, published at Philadelphia, in 1802.

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* See Mr. Tilloch's valuable Philosophical Magazine, &c. Vol. xiii. p. 376, &c. &c.

† See Part First, p. 18, 48.

‡ Dr. Amos Gregg, jun.

LAURUS Sassafras. In the First Part of this work, I have made mention of the oil of this vegetable, and have hinted at its affinity to camphor†. The resemblance between the two articles is further evinced by this circumstance, that the oil of Sassafras, when externally applied to the body in rheumatic and gouty affections, is remarkable for its power of shifting the pain from its original seat; *but not always to the advantage of the patient.* Like camphor, therefore, it ought ever to be used, in such affections, with great caution. I believe, however, that it is a medicine well adapted to many cases of rheumatism, in its chronic stage; though even here it may prove injurious.

THE Phytolacca decandra, well known by the names of Poke, Garget, American Nightshade, &c., is one of the most common North-American plants. It is, certainly, a plant of great activity, though the young shoots, when boiled, may be eaten with impunity, and are justly deemed a great delicacy. By many, they are preferred to the finest asparagus.

SOME of the medicinal powers of this plant have long been known. The ripe berries, infused in brandy, or wine, especially the former, are a popular remedy for rheumatism, in many parts of the United-States. This tincture of Poke (*Tinctura Phytolaccæ*) is certainly a valuable medicine in cases of chronic rheumatism, and other similar affections. Like the volatile tincture of gum Guaiacum, it has sometimes done injury; as might indeed be expected from an active medicine, in the hands of the injudicious or ignorant. It may, I believe, be safely exhibited in most of the cases of rheumatism, in which the Guaiacum has been used with safety and advantage. In the rheumatic affections, which frequently succeed to the venereal disease, it seems to be a more valuable medicine than the Guaiacum, and may be advantageously employed, especially along with calomel, or other preparations of mercury. I have employed the ripe juice of the berries, inspissated to the state of an extract, in some cases of scrophula. The juice, in the same state, has, I am informed, been advantageously employed in cases of cancerous ulcers. These ulcers were dressed with the extract, spread upon linen, or upon the leaf of the plant. But the juice of the leaves, applied in the same manner, is said to have been found more efficacious. I am inclined to repose some credit in the testimonies which I have collected concerning the utility of the extract of Poke, in the cases just mentioned.

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* A few drops of this tincture, poured upon the body of a large and vigorous rattle-snake, in my possession, killed the reptile in a very short time. It violently affected the animal, *almost instantaneously*.

† Pages 19, 20.

THE reader may consult, with advantage, *An Inaugural Botanico-Medical Dissertation on the Phytolacca Decandra of Linnæus*. By Benjamin Shultz*. As a repository of facts concerning the Phytolacca, this dissertation is valuable, and worthy of attention. But the subject is still, in a great measure, a new one.

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* Philadelphia: 1795.

Arum triphyllum[*]. The recent root of this plant boiled in milk, so as to communicate to the milk a strong impregnation of the peculiar acrimony of the plant, has been advantageously employed in cases of consumption of the lungs. I have heard of one case (that of a negro man in Virginia) who was completely cured of a pulmonary consumption by continuing to take, for a considerable time, milk in which the root of the Arum had been boiled. It would certainly be worth trying this simple prescription in some cases of a disease which so generally baffles the powers of all our medicines, and the skill of the best physicians. I am not ignorant, that within the period of a very few years, the disease of consumption has been supposed to be deprived of some of its terrors; but I must add, with real regret, that notwithstanding the high encomiums which have been bestowed upon the Digitalis as a remedy for this disease, by some distinguished medical philosophers, and practitioners[†], I have employed this vegetable in a considerable number of cases of consumption, and, upon the whole, with very inconsiderable *permanent* advantage. In one case, indeed, it *seemed* to perform a cure of what I deemed genuine phthisis: in several other cases, it evidently and remarkably affected the pulse, and moderated the urgency of the symptoms; but the patients ultimately fell victims to the disease. Some of the patients to whom I exhibited the Digitalis were so far advanced in the disease, that little benefit could have been expected from medicine of any kind: but others of them again were in the earlier stages of the disease, and consequently in a situation that seemed to admit of permanent relief, from this or from other medicines. Yet, with the exception of the case already hinted at, I have not been able to effect a single cure by means of Digitalis. I am even inclined to think, that I have, in several instances*, more considerably arrested the progress of phthisis pulmonalis by means of emetics (particularly the sulphat of zinc, exhibited in the manner recommended by Dr. Moseley†) than by Digitalis. Candour compells me to add, that my own experience with the Digitalis in consumption has been less than that of several other practitioners in Philadelphia, some of whom entertain a more favourable opinion of the medicine, as a remedy for consumption, than I do.

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[*] Part First, p. 21, 49, 50.

[†] Mr. Saunders, Dr. Thomas Beddoes, Dr. N. Drake, &c. &c.

DR. STORCK, of Vienna, has called the attention of physicians to a species of Clematis, or Virgin's-Bower, the Clematis recta‡. This is a very acrid and active plant, which Storck recommended in cancerous, venereal and other malignant ulcers, and also in obstinate pains of the head, and bones, and in other diseases. An infusion of the flowers or leaves, and an extract of the plant were used internally. The powder was sprinkled upon the ulcers, where it was found to act as an excellent escharotic and detergent.

I DO not know that the Clematis recta is a native of any part of America. I have been led to mention the plant in this place, because the United-States afford us some species of the same genus, which, from a few experiments that I have made with them, promise to be useful in medicine. The species which I have more particularly attended to, are Clematis crispa, and Clematis Viorna. The leaves of these species are extremely acrid, and may be found useful in chronic rheumatism, palsy, old ulcers; and, in fine, in all the diseases in which Storck found the Clematis recta useful[*]. As they are very active plants, it is necessary to use them in small doses. I have received some obscure information concerning the employment of one of the species (I think C. crispa), in Virginia, as a remedy in some particular affections.

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* Especially in the Pennsylvania Hospital, in the summer of 1803.

† A Treatise upon Tropical Diseases, &c. &c. p. 541, &c. London: 1792.

‡ Upright Virgin's-Bower. Storck calls the plant Flammula Jovis. It is a native of Austria, Hungary, Switzerland, and France.

DR. SCHOEPF has made no mention of these plants, but has proposed the employment of Clematis Virginiana, as a substitute for Clematis recta[†]. The C. Virginiana is a much more feeble plant than either of the three other species which have been mentioned.

§ II. TOPICAL STIMULANTS.

THE Pyrola umbellata, already mentioned, may be noticed under this head. The bruised leaves of this plant, when externally applied, sometimes induce redness, vesication and desquamation of the skin. But this is by no means a constant operation of the vegetable; and, therefore, it does not seem particularly worthy of our attention, in this point of view.

RHUS radicans[‡]. The following observations, relative to the deleterious property of this common plant, will not, I hope, be unacceptable to those who are interested in a knowledge of its natural history. The person who is the subject of the observations, has, for many years, been severely affected by the plant; and although many other persons are similarly affected, it is not often, I believe, that the progress of the poison is marked with minute attention in those who are injured by it.

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[*] See Elements of Botany, &c. Part Third. p. 70.

[†] Materia Medica Americana, &c. Praefatio. p. xiii.

[‡] See Part First, p. 23, 50, 51, 52.

On the eighth day of July, 1795, I applied two or three drops of the milky juice whilst it issued from the common foot-stalk of the leaves of the Rhus radicans, to the risband of my shirt. These leaves, immediately before, had been torn from the stalk of the plant, by a friend of mine*. My object, in applying the juice, was to determine, in what length of time it would assume the black hue. In a few minutes, I found that the linen was stained black, and in a short time after this, I observed that the juice had penetrated through the risband, and that it had communicated a dark brown or blackish colour to that portion of the epidermis which was immediately under it. The day was unusually warm, and I went into the water to bathe. In the evening, I felt a considerable itching of my wrist, and the following morning observed, that there were upon it a number of extremely minute vesicles, which contained a fluid more or less limpid, or transparent. The itching increased hourly: the wrist and the middle of the fore-arm began to swell, and the vesicles extended themselves rapidly, chiefly upwards, towards the elbow, and partly downwards, along the lower part of the wrist and upon the fingers.

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* I was not myself within the sphere of the action of the plant, which I was careful to avoid, well knowing, from long experience, its injurious effects upon me.

MEANWHILE, vesicles accompanied with, and preceded by, itching more or less troublesome, made their appearance, upon various other parts of the body. The face was universally sprinkled with them. But these were extremely small, the fluid which they contained, was always very limpid, and without any application, except that of cold water every morning, they entirely disappeared in two or three days.

ABOUT the seventh or eighth day, the itching, the inflammation, and the spread of the vesicles appeared to be nearly at their height. At this period, and for some days afterwards, the greater part of the fore-arm, and about one third of the arm were swelled to nearly twice the natural thickness; the itching was intollerable, and the vesicles, in general, were no longer filled with a limpid fluid, but contained a thick matter, or pus, very similar to that of small-pox, and strongly adhering to the linen.

ON the ninth day, I perceived a swelling in the axillary gland of the right arm, which was that to which the lacteous juice was applied, and which was chiefly affected. The swelling rapidly encreased, until it became of the size of a hen's egg, and on the second day from its appearance, it had almost entirely evanished.

FROM the period that the swelling was at its height, to its entire disappearance, the itching was almost universal, and much more insupportable than it was before. I attributed this itching to the influence of the poison, which, I suppose, was conveyed into the system, from the time that the axillary gland began to swell and inflame. Nevertheless, I could not discover that there was, in consequence of this supposed absorption of the poison, any increase of the number of vesicles upon the surface of the body.

In fifteen days from the time that the poison was first applied to my arm, all the disagreeable symptoms had ceased; the vesicles had almost entirely disappeared; a desquamation of the affected parts had taken place, and a new epidermis had been formed.

From the foregoing statement, it must appear evident, that to some constitutions the milk-like juice of the Rhus radicans is capable of producing very disagreeable effects. It must not, however, be imagined that these effects are equally disagreeable to all constitutions; and it is certain that there are *many* persons who are not at all affected by this plant.

It has been asserted, that persons of the most irritable habits of body are the most liable to be effected by the Rhus radicans, and by some other species of the same genus. I do not intend to oppose myself as an exception to this position; but from the recollection of the constitutions of several persons to whom this poison has been applied, I have very little hesitation in asserting, that the susceptibility of receiving its influence is by no means proportional to the degree of irritability, whether muscular or mental, of the habit. It may, I believe, be asserted with much more truth, that the susceptibility of receiving the influence of the poison of the Rhus radicans is somewhat proportional to the delicacy and thinness of the epidermis and skin. Hence, no doubt, it is that females are more liable to be poisoned by this plant than males; that the face is seldom so much affected by it as the arms, the genitals, and most other parts of the body that are protected from the constant influence of the air; and that young persons are more frequently poisoned than those who have arrived at the age of manhood, or who have passed to the term of older age.

I HAVE said, that there are many persons who are not, in the least, affected by the poison of the Rhus radicans, externally applied. This is an undoubted fact. Some of these persons after expressing the juice of the plant, will rub it upon their arms, and other parts of their bodies, without experiencing the smallest injurious effect. I am acquainted with two gentlemen, who find no ill effects from chewing, for a considerable time, the recent leaves of this plant. It deserves to be mentioned, that one of the gentlemen, I allude to, is liable to be considerably injured by the effluvia of the Rhus radicans, when applied to the external surface of his body.

IT may not be improper to observe, in this place, that several other native plants besides the species of Rhus, and the Pyrola umbellata, induce in certain persons, a vesicular state of the skin. The flowers of the Kalmia latifolia, or Broad-leaved Laurel, have been known to do this in some persons. I knew an elderly lady who was affected, in the same way, by the Nerium Oleander, or Common-Oleander, or Rosebay. But this last is not an American vegetable.

A DECOCTION of the bark of the Rhus radicans has been used, with seeming advantage, in some cases of consumption of the lungs, in different parts of Pennsylvania. A gentleman of my acquaintance (who has since fallen a victim to the disease) informed me, that he had certainly found much benefit from this decoction in a pulmonary affection, complicated with *fistula in ano*. A decoction of the root of the plant is said to have been advantageously employed in cases of asthma.

A LATE writer, M. du Fresnoi, strongly recommends the Rhus radicans, in the treatment of herpetic affections, and in paralysis. In the first of these cases, he employed the infusion and the distilled water of the leaves of the plant. He relates seven cases, which seem to establish, unequivocally, the efficacy of these preparations in the affections which I have mentioned. He says he cured five cases of paralysis by the use of the plant*. Dr. Alderson informs us, that he has used the Rhus Toxicodendron, with much benefit, in the same disease†.

THE bark of the Rhus glabrum, or Smooth Pennsylvania Sumach‡, boiled in milk, has been recommended as a remedy for chronic ulcers; and, I am informed, has been found very useful. The ulcers are often washed with the decoction.

SECTION IV. SIALAGOGA.

I HAVE nothing additional to say under the head of particular ERRHINES, and therefore proceed to the section of SIALAGOGA, or SALIVATING medicines. Between these and the Errhines, there is a very great affinity; as is evinced by this circumstance, that several articles of the materia medica, both minerals and vegetables, very frequently act by increasing the secretion by the nose, and also that by the salivary glands. This is remarkably the case with respect to the sulphat of mercury, or turpith-mineral; and, in one instance, I think I have seen a salivation decidedly induced by the use of the turpith mineral, in combination with tobacco, that had been used, for some weeks, as an errhine. This will the more readily be admitted as a fact, when we read, that a very extensive salivation of long continuance, has been apparently induced by an irritation applied to the parotid gland, through the medium of the *meatus auditorius*. The irritating substance was a portion of fetid wool[*]. It would be an easy task to cumulate facts to prove, that "the number "of salivating medicines is much greater than has been "commonly imagined[†]."

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* Des proprietes de la plante, appellee, Rhus radicans; de son utilite, &c. &c. A Leipsic: 1768. I have not seen the original work.

† An Essay on the Rhus Toxicodendron, or Pubescent Poison-Oak, or Sumach, &c. By John Alderson, M. D. Hull: 1796.

‡ Part First, p. 51.

POLYGALA Senega, or Seneca Snake-root[‡]. My ingenious pupil, Dr. Thomas Walmsley has lately communicated to me an additional instance of the salivating power of this active vegetable. The patient (a lady aged about ...... years) had taken, for some time, a decoction of the Seneca, and was thrown into a profuse ptyalism, which continued for a considerable time.

IT is a well-ascertained fact, that the disease of tetanus has often been induced by different poisonous vegetables: by Datura Stramonium, Hyoscyamus albus, or White-Henbane, not to mention several others. The same disease is likewise sometimes induced by the *healthy* or natural poisons of certain animals. I have collected two well-authenticated instances of the production of this disease, by the bites of venemous serpents, in the United-States. One of the patients died. The tetanus did not come on until six or seven days after she was bitten. The other recovered from the disease, by the use of large doses of the Seneca, boiled in milk[*]. I know not whether this instance of success should encourage us to hope that the Seneca might be given, with advantage, in those cases of tetanus which are the consequence of wounds, in different parts of the body. I fear that our vegetable, though by no means a feeble one, will be found unequal to the cure of this terrible disease.

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[*] See Medical Transactions, published by the College of physicians in London, vol. II. p. 34, &c.

[†] See Part First, p. 24,

[‡] See Part First, p. 25.

THE Zanthoxylum Clava Herculis and Zanthoxylum fraxinifolium are both mentioned in the First Part of these *Collections*[†]. They are both vegetables endued with very active powers. The bark promises to be a very useful medicine in cases of paralytic affections of the tongue, or of the muscles concerned in deglutition: and in such cases, when held in the mouth, they have been employed with advantage[‡]. They are more active than Mezereon (Daphne Mezereum), which both Dr. Withering[§] and myself have employed, with a good effect, in the same cases. It might, perhaps, be worth trying the Zanthoxyla, as masticatories, in some cases of stammering.

IN some parts of Virginia, the berries of Zanthoxylum fraxinifolium are much esteemed as a remedy in violent cholicy affections. A spirituous infusion of the berries is employed. They are known by the name of "Suter's-berries."

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[*] See Elements of Botany, &c. Part Third, p. 105.

[†] See p. 25, 52.

[‡] By Dr. Tucker Harris, of Charleston, South-Carolina.

[§] A Systematic Arrangement, &c. vol. II. p. 370.

FOR some interesting notices concerning the use of the bark of Zanthoxylum Clava Herculis, in rheumatic affections, in ulcers, &c. &c. &c., I refer the reader to different communications, in the *Memoirs of the Medical Society of London*[*], and other periodical publications.

SECTION V. EMETICS.

SPIRÆA trifoliata[†]. This is sometimes very injudiciously employed by the country-people, insomuch that they are obliged to apply for medical aid to remove the debility induced by the large doses of the root which they employ. "It is said, that there grows in the state "of Kentucky, another species, which is still more "valuable, as an emetic, than the S. trifoliata[‡]."

THE emetic power of the Sanguinaria Canadensis, of which I have taken notice in the former part of this work[§], has been fully established by the experiments of Dr. Downey, in his ingenious essay upon this plant. The "most prominent effect" of the medicine is to induce vomiting, even when it is exhibited in moderate doses. "When taken in the dose of fifteen or twenty grains," it exerts powerful emetic qualities. "But in consequence "of the irritation, which is produced in the fauces, it is

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[*] Vol. V.

[†] Part First, p. 26.

[‡] Elements of Botany, &c. Part III. p. 89.

[§] Page 27.

"probable, that in the form of a powder, it will never "come into general use. This inconvenience may, however, be obviated, by giving it in form of a decoction "or extract." When managed with care, it is deemed "but little inferior to the ipecacuanha, either in the certainty or speediness of its operation*. The powder of "the root may be given as an emetic for an adult, in the "dose of fifteen or twenty grains, made into pills, otherwise a considerable irritation will be produced in the "fauces in taking it†."

HITHERTO, the Sanguinaria has been but little employed by the regular practitioners. It promises, however, to be an useful medicine, particularly on the foundation of its emetic and expectorant effects, in cases of cynanche maligna, or ulcerous sore-throat, in cynanche trachealis, or hives, and other similar affections. Its properties seem to be considerably allied to those of the Seneca Snake-root, which has been so beneficially employed in the same cases‡. I have received an account of its having been employed, in the shape of a decoction, with very evident good effect, in the case of that particular form of cynanche trachealis, which Dr. Darwin has named *Peripneumonia trachealis*§. The medicine proved emetic, and the patient recovered.

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* An Investigation of the properties of the Sanguinaria Canadensis, or Puccoon. By William Downey, of Maryland. Philadelphia: 1803.

† An Investigation, &c. pages 23, 25.

‡ See Part First, p. 33, 34, 54, 55.

§ Zoonomia, or the Laws of Organic Life. Vol. I. The disease of hives appears under several different shapes, in all of which the trachea seems to be essentially affected. In the course of my practice, I have met with some cases, which answer precisely to Darwin's description, and for which I think the term peripneumonia trachealis is a very appropriate one. If I do not mistake, this form of the disease, in general, more readily admits of early and complete relief than any of the other shapes in which it appears.

I HAVE already observed, that the seeds of the Sanguinaria "appear to possess nearly the same quality as the "seeds of Datura Stramonium[*]." That is, they induce fever, delirium, dilatation of the pupil of the eye, &c. Dr. Downey concludes, from a few experiments, which he made with the "unripe seeds," that they possess a very considerable influence over the pulse, and "a stupifying or narcotic quality[†]." A deleterious property evidently resides in the leaves of the plant[‡] as well as in the seeds.

SECTION VI. CATHARTICS.

UNDER this head, in the former part of the work[§], I have mentioned the Asclepias decumbens, commonly called Pleurisy-root, Flux-root, &c. The root of this plant does, unquestionably, possess a purgative quality. But this does not seem to be the most valuable part of its properties. It is said to possess a remarkable power of affecting the skin, inducing general and plentiful perspiration, without greatly increasing the heat of the body. Accordingly, I find it is much employed by the practitioners of medicine in some parts of the United-States, particularly, I believe, in Virginia, as a remedy in certain forms of fever, in pleurisy, and other affections. The root is used both in powder and in decoction.

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[*] Part First, p. 27.

[†] An Investigation, &c. p. 24.

[‡] Ibid. p. 24.

[§] Page 29. See, also, page 53.

Sometimes, it is used in combination with antimonials. The decoction often induces perspiration, when other medicines have failed to produce this effect. A physician*, who has been much in the habit of employing this Asclepias, informs me, that 'in the low states of 'typhus fever, he has more frequently observed a per-'spiration to succeed to the use of the Asclepias than to 'any of the sudorifics that are generally used.'

About thirty years ago, this vegetable was strongly recommended, as a specific for pleurisy, by a Mr. Thomson Mason, of Virginia. After the use of an antimonial emetic, and the loss of some blood, he gives his patients "as much of the Pleurisy-root, pounded very fine, and "then searched through a fine search, as will lie upon "a tolerable broad case knife, in a cup of warm water, "and repeats the dose every two hours, until the patient "is perfectly recovered, which happens frequently after "three days, and never fails freeing him from pain after "six." Mr. Thomson assures us, that by these simple means, he "has cured hundreds, and never failed in a "single instance."

It does not appear, that Mr. Thomson was a regular physician; but I have been led to mention his practice the more particularly, because his publication seems to have first called the attention of the public to the virtues of the Pleurisy-root, and I know that some very respectable physicians, in Virginia†, have reposed not a little confidence in the powers which our author has ascribed to the medicine, as a remedy in the cases in which he employed it.

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* Dr. Charles Everett. Letter to me, dated Milton, October 23d, 1803.

† Among others, my friend, the late Dr. James Greenway, of Dinwiddie-county, in Virginia. From this gentleman, I received a copy of Thomson's paper, which I think first made its appearance in an Almanac, in 1773.

From Mr. Thomson's publication, it also appears, that the Pleurisy-root may be given in pretty large doses, perhaps about half a dram, several times in the course of the day. Indeed, I find that the Virginia physicians are not very nice in the doses of this medicine, when they prescribe it.

It seems that Mr. Thomson entirely confined himself to the use of the Asclepias decumbens, or the species with beautiful orange-coloured blossoms. He observes, however, that there are two other species of the Pleurisy-root, which are known by the name of "Butterfly-weed." It is probable, therefore, that these two kinds (one of which I take for Asclepias Syriaca, well known by the names of Wild-Cotton, and Cotton-plant) have sometimes been used for the Asclepias decumbens; and it is not unlikely, that a common assemblage of properties belongs to a number of the species of this fine family of plants. Asclepias Vincetoxicum, which is a native of Europe, has been recommended by some writers on the Materia Medica, as a remedy for dysentery, and other diseases.

I have already mentioned* the extract of the Juglans cinerea†, or Butternut-Walnut. This appears to me to be one of our most valuable native cathartics. It is well adapted to the treatment of dysentery, in which, however, it seems to operate merely as a laxative. A decoction of the inner bark (*liber*) of the tree has been very advantageously used as a cathartic, in that malignant fever of our horses, called the yellow-water, which I formerly noticed*.

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* See Part First, p. 31.

† Juglans oblonga alba of Marshall.

The green or unripe fruit of this vegetable is considerably acrid, and when applied externally to the skin, induces some irritation there. Advantage has been taken of this property by the country-people in some parts of the United-States. They apply the cut end of the fruit to those milk-white spots which often appear upon different parts of the body, and seem to arise from a removal of the *rete mucosum*, or perhaps rather its colouring matter, from the skin. A surgeon, whom I met with in the remote parts of the state of New-York, in the year 1797, informed me, that he had known the Butternut employed with the effect of entirely removing the white *maculæ*, or spots in some persons. I should have confidently ascribed the removal of these spots to the stimulant operation of the juice of the nut, if I had not been assured, that similar affections are sometimes removed by the simple application of cream and other articles, which can hardly be supposed to operate by virtue of a stimulant power. I am, however, the more inclined to ascribe the removal of the spots to the stimulant action of the nut, because in a case of this kind, that came under my own notice, I found much advantage from the application of a blister of cantharides to the affected parts. The spots were not only prevented from increasing, but were very sensibly diminished in size, by the action of the cantharides. I have the satisfaction to believe, that by this simple treatment, I prevented the colouring matter of the mucous membrane from being entirely removed from one side, at least, of the face.

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* See Part First, p. 12.

I SHALL close this article by observing, that the spots of which I have been speaking, are mentioned by different writers, but by none, I believe, more particularly or correctly, than by my learned friend Professor Blumenbach, of Gottingen. After speaking of the white spots which often make their appearance upon the bodies of negroes, and other dark-coloured people (see his section *cutis fusca maculis candidis variegata*), he has the following words: "Niveae vero istae et aequabiles mollesque "maculae quae non nisi actionem alienatam vasculorum "minimorum corii sequuntur, neutiquam inter Aethiopes "tantum verum etiam passim inter nostrates occurrunt; "mihique ipsi bina istiusmodi exempla in Germanicis "hominibus observandi occasio fuit, alterum viri juvenis, "alterum senis sexaginta et quod excurrit annorum. "Utrique cutis subfusca hinc illinc maculis diversae "magnitudinis candidissimis distincta: quae vero neutri "connatae, sed isti infantili aetate, huic contra virili sen-"sim et sua sponte subortae fuerant*."

SECTION VII. DIURETICS.

I HAVE little to say under this head. I believe, however, that it is a fact, that several of our indigenous vegetables, of which no notice has been taken in the preceding part of the *Collections*, are very powerful Diuretics: but my knowledge of these plants is, as yet, very imperfect.

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* De Generis Humani varietate nativa, &c. p. 154, 155. Gottingae: 1795.

THE Erigeron Philadelphicum, or Philadelphia Flea-Bane, is one of the most common plants in many parts of the United-States. A decoction or infusion of the plant has been used in Philadelphia, by several persons, for gouty and gravelly complaints, and some of them have informed me, that they have been much benefited by the use of the plant*. It operates powerfully as a diuretic, and also as a sudorific. This Erigeron is known in Pennsylvania by the name of Skevish, which I suspect is a corruption of the word Scabious. But it must be confessed, that the genera Scabiosa (Scabious) and Erigeron are sufficiently remote from each other.

I HAVE never employed the Erigeron Philadelphicum, in practice: but I am led to believe, that there is *some* foundation for the assertions which I have noticed, because I find that the same plant is mentioned by Father Loureiro, as one of the remedies that are employed by the people of Cochinchina; and he speaks of it as an active emmenagogue†.

IN Virginia, there is a plant called "Piss-wort," which is deemed a very powerful diuretic. I am unacquainted with the plant, which, however, has been mentioned to me by a respectable physician, who informs me, that he once saw a strong decoction of it given to a horse, labouring under strangury, with the effect of suddenly exciting a very copious flow of urine. Perhaps, it will be found that this plant is a species of Menispermum, or Moon-seed, of which genus there are several species indigenous within the limits of the United-States.

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* See Elements of Botany, &c. Part Third. p. 123.

† Flora Cochinchinensis, &c. Tom. II. p. 500. Ulyssiponæ: 1790.

SECTION VIII. ANTILITHICS.

BY this term of ANTILITHICS, I mean those medicines which give relief in the disease of *lithiasis*, or calculus, and also in nephritis when this depends upon the same causes that induce calculus, such as a gouty diathesis, not to mention others. I prefer this term to the old one of LITHONTRIPTICS, which has so generally been employed to denote a set of medicines which produce the effects I have mentioned. Lithontriptics, in the rigid sense of this term, are, I think, unknown to us; though I do not deny, that the long-continued use of lime-water and other similar medicines, may on some occasions, have acted partially by dissolving, or otherwise altering, the surface of urinary and other calculi. Meanwhile, we are certain, that in many instances where Uva Ursi and other medicines have greatly relieved the distressing symptoms induced by calculus, the latter has remained undissolved, and its form, perhaps, not in the least, altered.

THE real mode of operation of the Antilithics is unknown to us. It seems highly probable, however, that many of them produce their effects by virtue of an astringent quality. We, at least, find that not a few of the astringents, such as Uva Ursi*, some species of Geranium, &c., do give relief in many cases of nephritis and calculus†. Dr. Cullen imagines, that the astringents act, in this case, by absorbing an acid in the stomach‡. But this appears to be a frivolous theory, unsupported by any respectable body of facts. The mode of operation of the astringents, is not completely understood; and in ascertaining the fact, that these medicines are antilithics, we have only advanced one step towards the discovery of truth. But whatever may be the precise manner of acting of the astringents in cases of nephritis and calculus, we are certain, that an antilithic property belongs to many articles which have little or no claim to the character of astringents. Such are some of the plants of the genus Allium, or Garlic, as the Leek (Allium Porrum), &c.: also carbonic acid, and carbonate of soda, not to mention several others.

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* See page 3.

† J. H. Heucher.

‡ A Treatise of the Materia Medica. Vol. II. p. 13, &c.

It is much to be regretted, that this most important subject should still be involved in so much uncertainty, notwithstanding the late laborious and ingenious inquiries of Fourcroy, Pearson, and other philosophers, who have favored us with the results of their experiments, relative to the analysis of human and other calculi. But on this subject much remains to be done; and although it is not probable, that we shall soon, if ever, discover a *solvend* for calculi in the body, it is highly likely, that a more extensive and correct acquaintance with the intimate nature of these concretions, will, in time, conduct us to a knowledge of the means of *preventing* their formation.

I have but little to say on the subject of particular Antilithics. Indeed, it must be confessed, that our catalogue of articles that are deserving of this title is very small.

Of the Uva Ursi, I have already taken some notice*. I have also observed, that the Pyrola umbellata has been employed with advantage in nephritic affections[*]. The good effects of the kernels of Corylus Americana have been noticed[†], as have those of the Philadelphia Flea-bane, or Erigeron Philadelphicum[‡]. I have not, however, employed any of these articles in the disease of nephritis, except the Uva Ursi, which is, unquestionably, a valuable antilithic. I have often prescribed this medicine, and have known it to be useful, even when it was ascertained that a calculus was present. It is certain that it does relieve the disagreeable symptoms which are the consequence of the irritation of a stone; and some facts which have come under my own observation, independently on those which I have met with in medical authors, have led me to believe, that the use of this astringent medicine facilitates the expulsion of calculous granules, through the urethra. In what manner this effect is accomplished, I am unable to say. I must add, however, that in *some* nephritic cases, Uva Ursi seems to increase the irritation which it so *generally* relieves.

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* See Part First, p. 9, 10 See also page 3, of the present part.

I HAVE already observed, that the root of Convolvulus panduratus "has been much recommended in cases of "gravel[§]." Since the publication of the former part of the *Collections*, I have received some additional and more certain information on this subject. In particular, I have learned, that an infusion or decoction of the root has been often used by a physician[‡‡] of New-Jersey, who has found the medicine very useful in his own case. He is persuaded, that it has enabled him to pass the calculous granules, with much facility.

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[*] See p. 2, 3.

[†] See p. 3.

[‡] See p. 46.

[§] See Part First, p. 54.

[‡‡] Dr. Harris.

SECTION IX. ANTHELMINTICS.

IT has been asserted, that Worms, as constituting a disease, are more common in America than in Europe. I suspect that there is some foundation for this assertion, though I am sensible, that the assertion ought to be received with some hesitation. A larger body of facts should be collected, before the truth can be completely established.

I HAVE already observed, that the Indian children, in some parts of the United-States, are very "subject to worms, and to the *larvæ* of insects, introduced into the system, along with their crude, and often unwholesome, aliment*." It is, moreover, a fact that great numbers of these children fall victims to the diseases induced by worms. This is acknowledged by many of the Indians with whom I have conversed. The Oneidas preserve a very curious tradition concerning one of these epidemick worm-fevers, and inform us, that in consequence of the destruction which it occasioned among their children, the nation relinquished a station which it had long occupied, on the margin of the Oneida-Lake, and took possession of another, at some distance from the Lake. It has, however, been asserted by some ingenious writers, that diseases from worms are unknown among the Indians†. My own observations and inquiries lead me to adopt a very opposite opinion. Indeed, the children of the Indians seem to suffer not much less from worms, and from dentition, than the children of the Europo-Americans.

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* See Part First, p. 37, &c.

† Dr. Rush says, he "cannot find any accounts of diseases from worms, among "the Indians." "Nor does dentition (he observes) appear to be a disorder among "the Indians. The facility with which the healthy children of healthy parents "cut their teeth, among civilized nations, gives us reason to conclude, that the "Indian children never suffer from this quarter." See An Oration, &c., containing an Enquiry into the Natural History of Medicine among the Indians of North-America, &c. &c. p. 26. Philadelphia: 1774.

WHATEVER foundation there may be for the assertion, that worms are peculiarly common in North-America, it will not be denied, that the subject of Anthelmintic medicines is one well worthy of attention. On this account, I shall introduce into this place a few additional notices on the subject. I begin with those vegetables which are most obviously characterized by a tonic quality.

A STRONG decoction of the bark of the Prunus Virginiana* has been employed, with a good effect, in some cases of worms. Whether this bark operates by any other than by a tonic quality, I am unable to say. It will not be denied, that many of the bitter tonic medicines are, on many occasions, excellent anthelmintics. But I am very far from believing, with some ingenious writers†, that the tonic medicines are always the best anthelmintics. In the epidemic verminose fevers, which often prevail in the marshy tracts of country, and are evidently owing to the same causes that induce common intermittents and remittents, the Peruvian bark and other similar medicines may be used with peculiar advantage. Moreover, tonics are at all times properly exhibited, with a view to prevent worms from increasing in the system. But many articles that are not at all, or at least very inconsiderably, tonic, are among the most valuable anthelmintics with which we are acquainted.

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* See p. 21, 22.

† Mr. James Moore. "Bark (says this author) is perhaps the best of all worm-'powders." An Essay on the Materia Medica, &c. p. 148. London: 1792.

THE Veratrum luteum*, commonly called Devil's bit, and BlazingStar, is entitled to notice. The root of this plant is a very pungent bitter, and is employed as a tonic, in some parts of the United-States. A spirituous infusion of the root is made use of. A tea, or watery infusion, of the root is often used, and is deemed an excellent anthelmintic. I presume, it does not operate merely by virtue of its bitter or tonic property. A narcotic quality seems to belong to this vegetable, and I am inclined to think, that its good effects, in cases of cholic, and perhaps, in cases of worms, are, in part at least, owing to this quality.

A WATERY infusion of the twigs and leaves of the Laurus Benzoin, formerly mentioned†, is often given to children, with a view to destroy and dislodge worms, and is deemed an efficacious medicine in this case.

THE root of the Sanguinaria Canadensis, exhibited with a view to its emetic effect, has, in some instances, dislodged worms from the stomach. Future experiments must determine, how far this active article is entitled to the character of an anthelmintic. Perhaps, Ipecacuanha, or any other emetic, would be found equally beneficial, in similar cases.

IN the course of my journey through Virginia, in the year 1802, I was informed, that the *ripe* fruit of the Persimmon (Diospyros Virginiana‡) has often been found very useful in the worm-cases of the negro and other children. I cannot discover any thing peculiarly active in this fruit, in the condition in which it is employed as an anthelmintic. Perhaps, it operates solely by virtue of a laxative property.

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* I take this plant to be the Melanthium dioicum of Walter. See my Elements of Botany, &c. Part Third, p. 157, &c.

† See Part First, p. 20.

‡ See Part First, p. 11.

I CONTINUE to use and experience the good effects of the Melia Azedarach*. I believe this is one of the most valuable anthelmintics, that has hitherto been discovered. Of late, the dried berries have been advantageously employed as an anthelmintic, in Carolina. With a view to this effect, children are permitted to eat the berries, without any particular regard to the dose. They are, by some, deemed as efficacious as the bark of the tree. I have employed the powdered leaves, but am not yet prepared to offer a positive report concerning their comparative powers. On the subject of the anthelmintic and other properties of the Melia, the reader will do well to consult my friend, Dr. G. Duvall's Inaugural Dissertation†.

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* See Part First, p. 39, 61, 62, 63.

† An Experimental Botanico-Medical Essay on the Melia Azedarach of Linnæus. By Grafton Duvall, of Maryland. Philadelphia: 1802.

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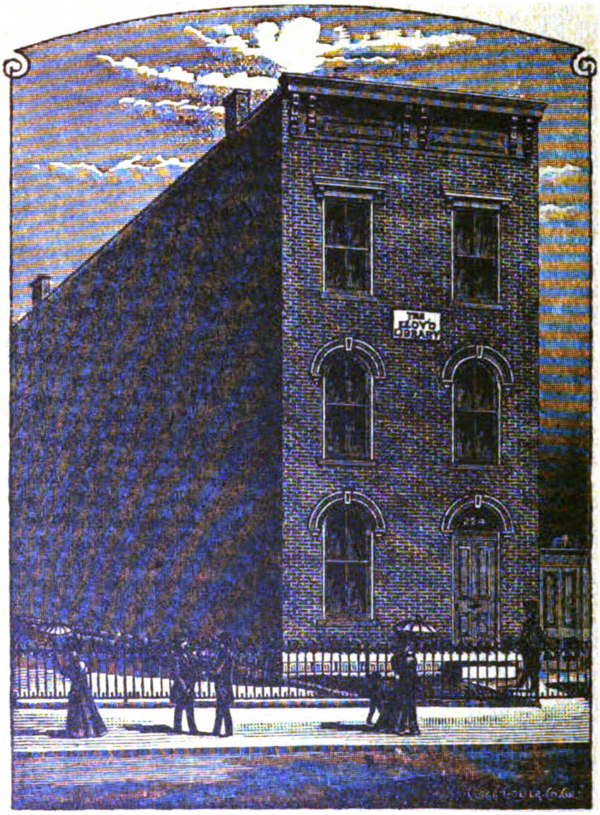
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BOTANY, PHARMACY AND MATERIA MEDICA

J. U. & C. G. LLOYD
CINCINNATI, OHIO

REPRODUCTION SERIES, No. 2

THE INDIAN DOCTOR'S DISPENSATORY
BEING
FATHER SMITH'S ADVICE
RESPECTING
DISEASES AND THEIR CURE

By PETER SMITH
Of the Miami Country

CINCINNATI
PRINTED BY BROWNE AND LOOKER
FOR THE AUTHOR
1812

WITH BIOGRAPHY BY JOHN URI LLOYD

BULLETIN OF THE LLOYD LIBRARY

The Lloyd Library was instituted for the purpose of collecting works on Botany, Pharmacy, Materia Medica, and the allied sections in science. To this was subsequently added a herbarium of flowering plants, and a micrological museum of dried hard fungi, and of fleshy fungi preserved in alcohol.

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Bulletin No. 1 consisted of a facsimile reproduction of Mr. Barton's rare work, "Collections for a Materia Medica of the United States," with portrait and Biography of the author.

The present Bulletin carries a complete reprint in facsimile of the rarest book connected with American Pharmacy, "Dr. Peter Smith's Dispensatory," of which, as is shown in our biography, but one copy is known to be in existence. We regret very much that no portrait remains to picture the face of this interesting personage.

Our third Bulletin will probably consist of a facsimile of the Materia Medica Americana, by Schœpf, the first botanical work connected with American medicinal plants.

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BIOGRAPHY OF DR. PETER SMITH.[*]

Close following the frontiersmen, whose footprints were scarcely rubbed out, and whose rifles had not yet been silenced in the territory embracing the Ohio Valley, came a band of men who cleared away the forest and founded their homes among the stumps. The subject of this sketch may be numbered among these people. He was a typical Puritan, an educated, stern man, of indomitable will, and religious to the utmost degree.

The end of the War of the Revolution had been consummated before the Indian had departed from the Miami lands, where this man lived. John Filson tramped from Lexington to the Ohio River, laid out the village of Losantiville, afterward Cincinnati, and, venturing too far from the fort, left his bones somewhere among the adjacent hills. This happened several years after the subject of this sketch was married. David Schœpf, the talented scientist, that energetic Hessian, who, after the surrender of the British, took his pack on his back and tramped over our land in search of American medicinal plants, had not yet written his *Materia Medica Americana*, which is the first systematic publication concerning the American Materia Medica.[1]

B. S. Barton, of the University of Pennsylvania, who, in 1798, contributed the first study of American drugs, from an educational institution,[2] and Samuel Thomson[3] the combative champion of lobelia, who fought the dogmatism, as he viewed it, of the medical profession, and introduced the Thomsonian method of medication, were contemporaneous with Peter Smith. C. S. R. Rafinesque,[4] that picturesque, gifted, erratic, enthusiastic scholar, had not landed in America when Peter Smith trod the Kentucky path.

Coming into the Ohio Valley from the South that he hated because of its slavery, preaching the Word of God and practicing medicine, Peter Smith, the representative of a class of men who sought neither fame nor gold, and who feared no privation, made his mark and passed away.

PETER SMITH'S DISPENSATORY AND ITS RECOVERY. "Peter Smith, the Indian Herb Doctor." The name was familiar during the writer's boyhood in Kentucky. It lingers yet about Western domestic medicine, and is occasionally seen in orthodox medical print. Rafinesque cited Peter Smith as one of the authorities consulted in the formation of his Materia Medica, but Smith's book was lost to sight. Tradition also told of a book by Peter Smith, but no such book was anywhere to be found. Second-hand booksellers, old men and women throughout the "Miami Country," old physicians' libraries, were appealed to in vain. Neither is a copy of this book to be found in the Surgeon General's library. The name of the man alone remained, the book that he wrote had vanished. Then at last, after a search of twenty-five years, the writer gave up in despair.

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[*] Read at the December meeting of the Cincinnati Section of the American Chemical Society. Revised reprint from the American Journal of Pharmacy, January, 1898.

[1] "Materia Medica Americana," 1787.

[2] "Collections for an Essay towards a Materia Medica of the United States," by Benjamin Smith Barton, M. D., 1798. See Bulletin No. 1, Lloyd library.

[3] See "A Narrative of the Life and Medical Discoveries of Samuel Thomson," 1822.

[4] "The Life and Writings of Rafinesque." Prepared for the Filson Club, Louisville, Ky., and read at its meeting, Monday, April 2, 1894, by Richard Ellsworth Call, M. A., M. Sc., M. D.

Last summer (1897), by invitation of Mr. Le Roy Brooks, the day was spent with the Toledo Club at Middle Bass Island, Lake Erie. General J. Warren Keifer, in speaking about old books, chanced to mention Peter Smith's Dispensatory, a copy of which he incidentally remarked he chanced to possess. The lost book was found, and, in addition, the history of its author was recovered, for Peter Smith was the father of General Keifer's mother. Added interest accrued from the fact that it was learned that the field of Dr. Smith's operations about Cincinnati was near the old Duck Creek church, a pioneer monument in the history of the Ohio Baptists, in which he officiated, being within a few moments' walk of the home of the writer.

HISTORY OF PETER SMITH.[1] Dr. Peter Smith was a son of Dr. Hezekiah Smith, of the "Jerseys," "*a home old man*, or *Indian doctor*." Peter was born in Wales, Februrary, 6, 1753, from whence this branch of the Smith family came. He was also a relative of Hezekiah Smith, D. D., of Haverhill, Mass. Peter Smith was educated at Princeton, and was married in New Jersey to Catherine Stout, December 23, 1776. He seems to have early, under his father, given some attention to medicine, and became familiar with the works of Dr. Rush, Dr. Brown, and other writers of his day on "physic," as well as with the works of Culpepper. He also, during his life, acquired much information from physicians whom he met in New Jersey, Pennsylvania, Virginia, North and South Carolina, Georgia, Kentucky, and Ohio. He called himself an "Indian doctor," because, as he said, he relied in his practice much on herbs, roots, and other remedies known to the Indians, though he did not confine himself to botanical remedies. He seems to have been an original investigator, availing himself of all opportunities within his reach for acquiring knowledge, especially acquainting himself with domestic and tried Indian remedies, roots, herbs, etc.

Starting from New Jersey about the year 1780, he commenced his wandering, emigrating life with his wife and "some" small children. He lingered for a time in Virginia, then in the Carolinas, and "settled" in Georgia. He sought out people from whom he could gather knowledge "of the theory and practice of medicine," and preached the gospel, possibly in an itinerant way. He was a devout Baptist of the old school. A strong anti-slavery man, even in that early day, he could not be content with his Georgia home, as he put it, "with its many scorpions and slaves." Accordingly, he took his family on horseback—little children, twin babes among them, carried in baskets suitable for the purpose, hung to the horns of the saddle ridden by his wife—and thus, without roads to travel, crossed mountains, rivers, and creeks. The wilderness was not free from danger from Indians, but he traversed the woods from Georgia through Tennessee to Kentucky, intending there to abide. But, finding that Kentucky had also become a slave State, the dogmatic old man and his family bid good-bye to Kentucky. He left that State with a parting shot to the effect that it was the home of "head-ticks and slavery," and emigrated to Ohio, settling on Duck Creek, near the Columbia Old Baptist Church, now adjacent to Norwood village, and near the limits of Cincinnati, reaching there about 1794.

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[1] Credit is due General Keifer for the facts that gave this information.—L.

He became, with his family, a member of the Duck Creek congregation, and frequently preached there and at other frontier places, still pursuing the double occupation of farming and the practice of medicine. In 1804 he again took to the wilderness with his entire family, then numbering twelve children, born in the "Jerseys and on the line of his march through the wilderness, the States and the Territories." He finally settled on a small, poor farm on Donnel's Creek, Ohio, in the midst of rich ones, where he died December 31, 1816. It seems from his book (p. 14), published while he resided at his last home, that he did not personally cease his wanderings and search for medical knowledge, as he states that he was in Philadelphia, July 4, 1811, where he made observations as to the effect of hot and of cold air upon the human system. It is certain that he not only taught to the end in the pulpit, but ministered as a physician to his neighbors and friends, often going long distances from home for the purpose. He concluded, near the termination of his long and varied experiences, that "Men have contrived to break all God's appointments but this: '*It is appointed for all men once to die.*'"

Peter Smith, preacher, farmer, physician, pioneer, aggressive Abolitionist before Wendell Phillips or William Lloyd Garrison were born, is buried in a neglected graveyard near Donnelsville, Clark County, O. No photograph or other likeness remains to revive the features of this picturesque personage.

Such is the life-record of this man, who, so far as the writer can determine, ventured to publish the first Western work on materia medica.

THE DISPENSATORY. It is to be regretted that Dr. Smith neglected the use of botanical names. His plants are all employed under common names, but he describes the appearance and habitat of each specimen so carefully as to enable the experienced reader to identify most of them. Rafinesque, who credits Dr. Smith's work, objects to his common names, which, however, are very interesting in connection with the text. The pains he takes to credit authorities from whom he obtained information is very refreshing, the relationship of these names to the substances used being useful to us to-day in connection with many drugs.

A few examples both of lost terms and others still in use may be cited:

Brinton's or Culver's Root.
Miami Columbo (American Columbo) Root.
The Nine-bark Root.

The Square-stalk Root.
The Corn Snake Root.
The Horse Balm.
The Mountain Mint.
The Sore Throat or Blueberry Root.
The Devil's Nip.
The Devil's Bit.
The Backache Root, etc.

Following the description and uses of simples come recipes for diseases, in which the originator of each compound is conscientiously credited. We find a few of these names familiar yet; *e. g.*, green ointment and ointment of red lead. Concerning this latter, he refers to an interesting Revolutionary incident where it had been used with good result on a soldier "who had been wounded at the Germantown battle, 1777, in the Revolutionary War. One of his legs had been broken and shattered while he was one of the forlorn party sent to tear down the fence and palings about Chew's house."

Passing to some of his remedies, we are reminded of the animal drugs of mediæval times; *e. g.*, a dead toad is recommended as an application to a wen, and Smith's remedy for toothache—well it would credit the animal extract men, past or present. Dr. Smith seems to have anticipated the cold-water curers (hydropaths), but he recorded his views in language which demonstrates that he stood close to some of the sanative surgeons of to-day. He says:

> "COLD WATER APPLICATIONS I reckon among the choicest of my discoveries.
>
> "The following I recommend:
>
> "When the accident of a bruise, piercing of a nail, a cut, a broken bone, an eye knocked out and put in again, etc., takes place, immerse the part in cold water as quick as possible, and then dip a large, soft linen cloth into cold water and apply it, and keep out the air. This cloth should be kept close; aid this by dropping cold water upon it for fifteen minutes, and continue it close for twelve hours. The inflammtion by this means will be kept back, and the cure by anything else will be almost forestalled; and then a bruise, a strain or broken bone, will scarcely swell at all; and a like application to a burn will have a similar effect. In about fifteen minutes the first pain will be over, and the future ease will be steadfast.
>
> "I have tried the foregoing application of cold water, with full demonstrations, for forty years past."

And that his observing eye caught yet finer lines is evidenced by the fact that he pointed out an "insect" theory of disease, and placed himself (pp. xiv, xv) in the ranks of the microbe theorists of to-day by asserting, in an extended argument, that the "plague, yellow fever, and other bilious and contagious complaints" were caused by "invisible insects;" and in accordance with his methods the Doctor takes pains to credit another for the suggestion.

But enough has been said concerning this upright, picturesque character, whose "Dispensatory" is reproduced in facsimile in the pages that follow, whose face has left no print, but who wrote the first Materia Medica "Dispensatory" published in the West. J. U. L.

THE

INDIAN DOCTOR'S DISPENSATORY,

BEING

FATHER SMITH'S ADVICE

RESPECTING

DISEASES AND THEIR CURE;

CONSISTING OF PRESCRIPTIONS FOR

MANY COMPLAINTS:

AND A DESCRIPTION OF MEDICINES,

SIMPLE AND COMPOUND,

SHOWING THEIR VIRTUES AND HOW TO APPLY THEM.

DESIGNED FOR THE BENEFIT OF HIS CHILDREN, HIS FRIENDS AND THE PUBLIC, BUT MORE ESPECIALLY THE CITIZENS OF THE WESTERN PARTS OF THE UNITED STATES OF AMERICA.

BY PETER SMITH,
OF THE MIAMI COUNTRY.

Men seldom have wit enough to prize and take care of their health until they lose it—And Doctors often know not how to get their bread deservedly, until they have no teeth to chew it.

CINCINNATI:
PRINTED BY BROWNE AND LOOKER,
FOR THE AUTHOR.
1813.

District of Ohio, to wit:

BE IT REMEMBERED, That on the twenty-ninth day of May, in the thirty-sixth year of the Independence of the United States of America, Peter Smith, of the said district, hath deposited in this office the title of a book, the right whereof he claims as author, in the words following, to wit:

"The Indian Doctor's Dispensatory, being Father Smith's advice respecting diseases and their cure, consisting of prescriptions for many complaints; and a description of medicines, simple and compound, showing their virtues and how to apply them. Designed for the benefit of his children, his friends, and the public, but more especially the citizens of the western parts of the United States of America. By Peter Smith, of the Miami country. Men seldom have wit enough to prize and take care of their health until they lose it—And Doctors often know not how to get their bread deservedly until they have no teeth to chew it."

In conformity to the act of the Congress of the United States, entitled "An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the times therein mentioned," and also an act entitled "An act supplementary to an act entitled 'An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such books, during the time therein mentioned,' and extending the benefits thereof to the arts of designing, engraving and etching historical and other prints."

ANGUS LEWIS LANGHAM,
Clerk of the District of Ohio.

ADVERTISEMENT.

THE author would notify the purchaser that he puts the price of one dollar on this book of advice, well knowing that 75 cents would be enough for the common price of a book of its size. He is conscious that propriety, perspicuity and brevity will be found marked on every piece—and if so, the shorter the better.

But those who do not chuse to allow him 25 cents for his advice, may desist from the purchase. He conceives that these advices are calculated to assist every citizen in the preservation of his health, and his recovery if diseased; so that by attending to them, he may easily receive 30, 60, or an 100 fold for his dollar: by which he may also meet the wished for assistance set forth in simples and preparations, that will be in his own power.

Besides, if a physician must be employed, the boss, or head of the family, ought to know so much about the work he hires his artist to do, as to be able to estimate the value of it. He claims this 25 cents as a small compensation for the labor and observations of fifty years, without having made his labor an emolument of advantage heretofore to himself or family.

The author is well aware that the public mind has been long impressed with these ideas: viz. "*The natives of our own country are in posssession of cures, simples, &c. that surpass what is used by our best practitioners.*" He conceives this publication will gratify such generally, whose minds remain under such impressions.

He presumes to add, that he conceives nature has made him a physician; and that to the best of his recollection, he has always remembered every thing that he has ever met with in a medical way, that he has counted valuable. In his youth he had a strong desire to become a student of physic, that he might act with propriety therein as a regular practitioner, but he was somehow providentially prevented; and it now appears to him, that his opportunities have been just such as to allow him to roam in search of every thing in the science of diseases, and their cure, and at length to satisfy himself, that generally speaking, his knowledge is accurate, and the prescriptions he has been able to make will be found valuable.

As diseases radically are but few, and may be all cured by but a few medicines, he conceives he has prescribed enough here for general use, and that they are the best that he has gained knowledge of.

PREFACE.

Something relating to the following work has been on my mind for twenty years past.

In my younger days I made a few memorandums and receipts; but finding as I advanced in reading a little on physic, and conversing with my friends who were physicians, that far the greatest part of them were trivial, I omitted making many more. However, having an insatiable taste and constant desire for relieving the afflicted and diseased, I have still been trying my hand from my youth up, and I am now in my sixtieth year.

My father, old Hezekiah Smith, of Jersey, was always, since I could remember him, *a home old man*, or *Indian Doctor*, with whom, in my raising, I contracted ideas, practice and experience, that have never left me.

There are a few things I wish to state in my preface.

I acknowledge the kindness of my friends in the medical profession, in every place where I have lived for forty years past, and I must acknowledge that I am conscious I shall transgress a little in publishing their communications without their express leave: but I console myself by recollecting, that great minds are generally liberal.

About thirty years ago I called on old Dr. Wilkey, a German, who had been in the business of his profession, in the Flanders wars. He proposed to me to spend a few days with him, to instruct me in some knowledge which he had gained in his long life, and which he regretted should die with him: especially to make his *Leotrill*, a liquid which he prepared; for the obtaining of which he had paid a large sum in Flanders. With this medicine he did many of his cures, both in physic and surgery. With this, said he, "I can put a person in a complete salivation in ten minutes. I need only throw this with a syringe into any sore, ulcer or wound, and it is fit at once for healing. Yes (said he) if there is a bullet lodged, it need scarcely ever be cut out; and a cancer in a woman's breast, I have never failed to cure with it." I only called to spend a few hours with this eminent old German, on my route from Virginia to Georgia, but have regretted, perhaps a thousand times, that I missed this great opportunity, so kindly proposed. I sometimes think of going yet to see his children (for he had some beautiful young folks, children by an English wife, when I was there) and try to obtain this Leotrill, and add it to my prescriptions.

There is an herb cultivated among the Germans, on the west side of the big Miami, I think it is in Montgomery county, particularly, I have been told, by the old Dunkard preacher, Jacob Miller. This herb, I have full reason to believe, is an infallible cure for the bite of the mad dog, or hydrophobia. I have seen this herb in powder, and was assured that only this was used for several, man and beast, where no scruple could be entertained of their having been bitten with a mad dog, and nothing of the dire complaint was experienced; while those creatures to which it was omitted, fell victims. I cannot describe this herb, nor do I remember its name. I remember the dose is only what you may lift on the point of a case knife in powder. This is to be eaten on a piece of bread and butter, three mornings successively, and the cure is effected.

I have mentioned the two foregoing remedies, that if I should never live to obtain them, other persons may avail themselves of them.

If vouchers for the efficacy of my medicine herein described, may be wished for, I can observe that Mr. Edward Bartholomew, who lived in Philadelphia and kept the excise office in 1790, was one of my patients. He was a very heavy fat man; one of his legs had been broken, which often inflamed, and appeared like mortifying. After he had given out applying to doctors, I undertook him; no cure, no pay. I saw him in Philadelphia, about fourteen years afterwards; he then gave me full credit for my applications, tho he had paid me in a few weeks after I first tried my means. His leg, when I first began with him, was as black as an old hat, and as big again as the other. My applications are described in Nos. 23 and 28.

Another voucher I will mention, is Mr. David Jones, a young Baptist minister, who lately lived with Dr. Samuel Jones, of Lower Dublin, Philadelphia county; who, residing a few years ago in the Miami country, I heard that he was sick, and went to see him. I found him attended by two doctors. His disorder was what I call the second grade of the bilious fever, attended with vomiting almost without intermission, which had then been for eight days. One of the doctors tarried with him, and I looked on, until the doctor and all present were convinced that he must die, and that quickly, unless something more effectual could take place. I then begged him of the doctor, who afterwards tarried with us for twenty-four hours.

I gave him my emetic, No. 1, and tho' he had thrown every thing suddenly from his stomach before, this lay on for about twenty minutes: he then had three or four reaches, which were moderate, throwing up considerable bile, notwithstanding his violent vomiting before. At this time we thought that alarming symptoms plainly appeared of an approaching mortification; at least his breath, mouth and tongue plainly shewed a putrid state: But all yielded to applications, which under God, effected a sudden cure. As soon as the above emetic had done, I began to apply No. 26, to overcome the cholic and spasmodic affections and No. 25, to act as a tonic, which succeeded so that in one hour he had manifest relief and ease. These two last numbers he continued to use, as directed in the present prescriptions; and in one week's time was able comfortably to ride about. He mended unusually fast, and became healthy and well; taking no other medicine. But he continued to take No. 25 three times a day, according to the prescription.

This mode of treating all bilious complaints, I have proved for several years past with general success; and several instances somewhat astonish me when I think of them. And I have found out that in learning to cure one, I have learned to cure them all. For all the bilious tribe of disorders, if I am not much mistaken, will yield to the process discribed in the case of Mr. David Jones.

But before I conclude, I wish to state my objections against the use of calomel. I learned in early life to give calomel both as a purge and as an alterative. And tho' I gave it, I believe, with the usual success, it is clear to me now, that I since have done much better without it. I have therefore left it out of my prescriptions.

In the winter of 1777, I inoculated about 130 persons for the small-pox. To the first parcel of them I gave calomel in the usual way, with jalap to work it off. The whole of them were allowed to have the small-pox very favorably, so that my practise justified itself. But I observed that every one whose physic had worked him pretty well, as we say, had a sufficient portion of the small-pox; but on the contrary those whose physic had scarcely moved them, all had it very favorably; I then concluded that I would try Warner's pills No. 28. And living at my father's house at that time, I had plenty of them, where they were always kept. Accordingly I gave them to my next squad of small-pox patients which were about twenty. Observing the abstemious diet usual, I gave them nothing till about one day before I expected the fever: then I gave a small portion of the pills above named in such a manner as to purge very little if any, which is usually the case when they are given. But what was very special, there were scarcely any of them that were sick with the fever—and they had small-pox scarcely enough to give any of them a receipt. Afterwards I proceeded with all the rest in the like manner, and with the same success; and of several families it might be said, they wanted two cooks for one nurse.

While I lived in Georgia, a very great attention was paid by almost every body there, to calomel and jalap; for after Dr. Rush's publications relative to the Yellow Fever, there was calomel and jalap prescribed for every thing; so that the poor old tartar emetic lay dead in the shops: and I, like other fools, gave it liberally, and it was thought to do well; and so I went on for some years, not considering that *all the cases* in Georgia, and other hot climates, during the nine warmest months, were *bilious*, and two-thirds of them in the other months, and always belong to debility; or what Brown's Elements state to be the asthenic diathesis; and in every instance, therefore, I think calomel is improper. Besides, I have noticed that when I gave No. 2 (which we had abundance of in Georgia) the relief was sudden; and if sudorific and bracing medicines were joined, to hold fast the advantage of the purge, the disorder was soon cured, and the patient became healthy. But the speedy restoration to good health was not half so common when the calomel was used; and besides, a state of languor frequently rested upon the patient who had taken calomel, with a dull heavy pain about the abdomen or stomach, attended with other expressions of remaining debility.

If ever calomel has been given to advantage, I conclude it has been in the pleurisy; but I will venture to compare notes at any time with those who use calomel, and only let me have No. 2 or No. 3, there being no comparison (commonly speaking) between the success with which the latter is marked and the former, both as to certainty and speed of the cure.

Now if we can do better without calomel than with it, both in debility and plethora, why should we not throw by the use of it? especially considering that the unhappy sufferer may perhaps happen to take a drink of cool water, or otherwise transgress. I then conclude

1. In bilious cases only, move the bile by taking No. 1, and then follow it with No. 4, or its preparations, or No. 5; then by some course keep up perspiration, and you need no calomel.

2. In plethoric and inflammatory cases, take No. 2 or 3, and bleed, if the pulse is high; mind to restore perspiration, then brace up a little (say by agrimoney tea) and you need no calomel.

I call myself an *Indian Doctor*, because I have incidentally obtained a knowledge of many of the simples used by the Indians; but chiefly because I have obtained my knowledge generally in the like manner that the Indians do.

I have indeed had the advantage in my early life of a slight classical education, and of reading some books on the medical business: such as Buchanan, Tissot, Sharp, Culpepper, a little on anatomy, Smith on the nerves, Brown, &c. But as I never pretended to live by my practice, I kept very little of the medicine of the shops; consequently my advices to my friends mostly were simples; and by this means I have by continued observation come to be of opinion, that our best medicines grow in the woods and gardens. I conceive, moreover, that my mind has providentially been led a step higher than the ancients or the Indians; their views being little more than "*This thing is good for that thing; this medicine will cure that complaint.*" But it stands demonstrated to me, that there are but two radical disorders (see Introduction chap. 2) consequently there need be only two classes of medicine.

In cases of debility, give No. 1 or No. 2, and then brace up, and correct the flatulence and spasms with No. 9, No. 25 and No. 26, promote a gentle respiration, and you will mostly cure all cases of debility.

The cases of plethora and irritation are to be corrected on as simple and general a plan.

Now since I have adopted these views, I seldom feel at a loss to know what ails any patient, or what medicine is suitable to apply.

I have here prescribed many things, so that you may have variety of choice.

Some cases, however, require a radical recruit of the iron property in the blood; and every thing will be in vain until that is done. Such I believe is consumption, derangement, &c. unto which stimulants should be applied; such as Nos. 2, 15, 16, No. 9 and 26, to take off the spasms and flatulence; but the radical cure should be attempted with No. 44 and No. 5. See No. 45.

I mention so many numbers not that they should all be used at once. Yet no one alone should be trusted to—and they may all or any of them be applied in their turns, should the first fail.

Dropsy, echronic-rheumatism, palsy, fits, cramps, &c. I conceive have the same root, and require the like treatment.☞But there are some medicines which become common to both diathesis: they are stimulants, and therefore proper to cases of debility in general. Yet when given in plethora and irritation, they soon carry the tide of flood to its summit, and by an easy transition bring on a salutary indirect debility. This may be noticed in the three first numbers and in No. 16, and 26. And corresponds with the use of opium generally. This may stand demonstrated in the pleurisy and other cases that are akin to it. When these stimulant medicines, therefore, are applied, they are not only proper for debility, but perhaps the best that can be for plethora and irritation. This we may rationally account for, when we consider that all emetics and cathartics operate on the principles of indirect debility.

My prescriptions in general I must leave to speak for themselves: I, however, feel a degree of satisfaction in thinking that herein I have in prospect the real benefit of my own children and of their rising, numerous progeny and my fellow men in general, as to their bodily comfort in this life.

INTRODUCTION.

CHAPTER I.

The *Doctrine* of *Respiration* I think somewhat important, because it will show the necessity of breathing good air.

An Indian, it is storied, when asked what he thought was the reason of the ebbing and flowing of the tide, made answer: "You know there is a great deal of odds between a big creature and a little one; a horse draws his breath a great deal slower than a mouse: the world is a big creature—he draws his breath only twice in the day and night; that makes the tide.

Now my intention is not to enquire about the tide, but to state to you how I think we draw our breath, or respire.

I consider the lungs to be the pump of life.—Fresh, cool air, drawn into the lungs or lights, immediately is rarefied by their heat, and is directly forced back again, in the same way that it was taken in; then we are by some means (voluntary or involuntary) disposed to fill ourselves again with fresh good air. Thus our respiration is carried on by the great author of our existence, to whose praise we ought ever to be ready to say:

"His spirit moves our heaving lungs,
"Or we should breathe no more,"

and however our lungs may act on the principles of the steam machine, and so operate from natural causes, we shall not always breathe.

Men have contrived to break nearly all God's appointments; but this "*It is appointed for all men once to die,*" has never been abrogated or defeated yet by any man. And we should always remember, when we are about to take medicine, *if the Lord will,* we shall do this or that with success; *if the Lord will,* I shall get well by this means or some other.

But to return to the breath—If the air be cool and clear it will always have elasticity, as it is called; it will swell and fly back again easily, when we receive it into our lungs. But if the air is warm or hot, we should soon find a difficulty to draw our breath. This was very sensibly experienced in New-York, New-Jersey and Pennsylvania, in which I witnessed it, being in those parts about the 4th of July, 1811; and I conclude that a farther degree of the warmth of the air, might soon have prevented us from respiring at all.

Such likely was the case in Calcutta, where a close room being filled with about 160 prisoners, it is said they all died except 18 in about 12 hours.

If the air is any how nearly as warm as the lungs, I cannot see how we should breathe at all: it is necessary therefore for us to try to breathe good air, if we would wish to live.*

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* In South Carolina I was once in company with old Dr. Dillihoo, who was noted for great skill and experience, having travelled into many parts of the world. In the course of our conversation, I asked him what he conceived the *plague* to be, which has been so much talked of in the world. He readily told me "that it was his opinion the plague is occasioned by an invisible insect. This insect, floating in the air, is taken in with

The motion and circulation of the blood is manifestly connected with our breathing. For every breath extends and contracts our lungs; and by this motion I conceive the valves of the heart are kept in operation; and every spring of the arteries and beating of the pulse are exactly in proportion to the operation of the lungs. When the breath is let out,

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the breath into the lungs, and there it either poisons, or propagates its kind, so as to produce that dreadful disease. This, he was confirmed, was likely to be the truth, from the experiments frequently made at Gibraltar. For there, said he, they of the garrison, when they fear the plague, have a way to elevate a piece of fresh meat, pretty high in the air; they put it up at night, and if it comes down sound and sweet in the morning, they conclude there is no danger of the plague. But if the plague is in the air, the meat will be tainted and spoiled, and sometimes almost rotten.

"He was farther confirmed in his opinion of the insect, because in and about tobacco ware houses, the plague has never been known." I will remark. Now it is well known that tobacco will prevent moths from eating our woolen clothes, if we pack but a little of it with them, that is, the moth cannot breed nor exist, where there is a sufficient scent of the tobacco—this scent may be death to the invisible insect even after they are drawn in with the breath and fastened upon the lungs. This may account for tobacco being burned (as I have heard it is) in many old countries, on a chaffing dish in a room, that the people of the house may take in the smoke plentifully with their breath, to preserve their health and prevent pestilential disorders.

Agreeable to this view, we may conclude that all tainted air may bring disease and death to us. And tho the plague has never been (properly speaking) in America, as we know of. Yet other effluvia taken in with the breath may have occasioned other fearful diseases: such as the yellow fever, and other bilious and contagious complaints.

the lungs are immediately, in their blood vessels, filled with blood ; and when the breath is drawn in again, the blood in the lungs is forced out into the heart. That is, they say, "From the lungs when the air is inhaled, the blood is pressed into the left auricle of the heart, from thence to the left ventricle, thence to the aorta, and by it and its branches through the body to the capillary extremities of the arteries, through them into the veins, and by the veins to the right auricle of the heart, from thence into the right ventricle, from thence through the pulmonary arteries, at the time of respiration or exhaling the air from the lungs, into the lungs."

Thus the lungs are alternately filling, first with blood, then with air, at every breath, the one pumping or working the other. By this circulation the blood runs its rounds, and is carried (at least some of it) to the extremities of the body in a few minutes; feeding our nerves, sinews and flesh as it passes on, and supplies and forces out that little juice through the pores of the skin, which we call perspiration and sweat.

From the blood vessels in the lungs is communicated a little stream of moisture, which grows into phlegm, and in a relaxed state produces that matter which is raised and coughed up from the lungs.

Indeed I consider that this motion and circulation of air and blood is the true cause of heat being kept up in the body ; and as the lungs have the most, and most violent motion, they possess the greatest degree of heat of any part of the body, and even heat the blood.* And it is by this motion, together with some irregularities, that a fever takes place, producing a kind of electrical charge. When this is attended with too much bile, or an undue portion of the gall of the liver, then the fever is called a bilious fever, and always belongs to the diathesis of debility; and if the weakness is very prevalent, the nerves and tendons tremble and start, and the strength to speak or act be suspended, this is called a typhous or nervous fever.

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* The heat of the lungs and blood ought, I think, never to be suddenly checked or counteracted by cold: especially when the weather is hot, or when violent exercise has raised unusual heat in the lungs, and thro'

But if there be a fullness of blood, a hard pulse, a fresh countenance, and an ability to speak and act with a degree of vigor or strength, then the fever may be called an inflammatory fever, and is exactly the opposite to the first mentioned. And your treatment must be accordingly. This belongs to the diathesis of plethora and irritation.

Here may we reflect on the balance of air and blood kept in motion to carry on life. For if the air and breath be suspended, how soon will death

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the system. Then take care how you go into cold water, to swim, or even to wash. Remember that cold will coagulate and clot blood—and that very soon if its motion and circulation should be much or suddenly abated. Ah! how many have lost their lives, or their health, or become cripples for life, just by such folly!

A large drink of cold water has often proved fatal when the lungs and blood have been so heated, for the reason before assigned.

Indeed, in very hot weather, I think very cold water ought to be used with caution; and in small quantities, at least until the stomach is moderately cooled by it.

I am persuaded that instead of taking cold drink, when we are very hot, and if we find it is with difficulty we get our breath, we had better take warm drink.

I have noticed how easy it is to breathe in the hottest seasons after I have drank a good dish of hot coffee.

ensue; * or if the blood be taken away, how soon will all vital motion cease.

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* A man who had been prisoner among the Indians, related to me the following most horrid incident.

Said he. "I was present at the burial of a squaw who died leaving a young child. When the Indians met to bury her, an old mother squaw took the infant child and offered it to every squaw in the company to take care of, but they severally refused : she then said, now then the mother must take care of it. She then taking hold of the child's nose with one hand, and applying the other to its lips, held them both fast closed. The event was that the child in a minute or two, struggled in death, and expired. She then laid it in the dead mother's arms, who were both buried together. He further said, that he could not but observe how well the old savage understood her business."

CHAPTER II.

The diathesis of diseases, agreeable to Brown's Elements, I conceive to be the truth. I became somewhat acquainted with this system about 22 years ago.

Agreeable to that plan, there are but two kinds of diseases of the humany body: consisting 1. in *Plethora* and *Irritation;* and 2 in *Debility, Weakness* and *Languor.*

Generally speaking, it is of importance for us to know to which of these an afflicted sufferer belongs. The cases I have compared to a lighted candle—if your candle burns strong and has a superfluous wick, then you may safely snuff it; but if it is dim, burns dull, and its wick is too short already, *you must beware of snuffing it,* lest you put it out. You had better pick open your wick, and gently feed the flame until you bring it to burn well.

Plethora and Irritation are not so critical. You may then bleed liberally; especially if the pulse is hard and high; No. 2 or No. 3 may then be given to great advantage. I have sometimes taken blood, and succeeded wonderfully, when mere stagnation had nearly prevented the pulse from beating at all.

But it is altogether *critical* in all cases of real debility to which belong all bilious cases, cramps, fits, hysterics, &c. Then blood ought very cautiously to be let, if at all. And all diuretic and weakening medicines, should be very cautiously given, and sometimes carefully avoided. Your treatment should be strengthening and what is called tonic. Such as No. 1, No. 5, No. 9, &c.

Consequently in consumptive cases, nothing in my view is more improper than calomel, British oil, Tar water, &c. And I think it no wonder that consumptions have so long proved mortal, when it is clear in my mind, that nothing but a recruit of good blood will affect the cure, such poor victims languishing under real debility and weakness. See my note to No. 44.

So that the elements by Brown seems to me plain, reasonable and practicable. But I have to say of his prescriptions, as David did of Saul's armour, when it was put upon him. "*I cannot go with this, for I have not proved it.*" He then chose his sling, his staff, shepherds bag and stones, because he was used to them, and could recollect what he had heretofore done with them.

I acknowledge myself highly indebted to Brown for his doctrines of excitability, of predisposition of diseases, and observation on the pulse. The nature and use of opium and other stimulants, and his opinion concerning the consumption, and its being a curable disease.

But I conceive that after all, he has in a measure missed the radical cause of the consumption, and that mere stimulants will never effect the cure. But since I have buried two or three of my own family with that fatal disease, the iron doctrine has been strongly impressed on my mind. See the note to No. 44.

The few experiments that I have been enabled to make, justify what I have inserted on that subject. I wonder that this doctrine has never been adverted to before (that I know of) especially when I consider that the iron in the blood has been long discovered, and that in Georgia and South Carolina the cachexy* is often cured with iron, when nothing else will cure it; that a recruit of good blood is frequently obtained by giving iron in female weaknesses; and that the observation may so fairly be made, that black-smiths and those that work in iron are never consumptive or dropsical persons.

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* The cachexy is a kind of dropsy, frequent in southern climates.

To Brown's opinion I assent in one thing more, for I am quite of his mind: to wit, *an old man ought never to marry a young woman.*

A word to the wise is enough.

CHAPTER III.

Obstructed Perspiration I suppose to be the real first cause of half the diseases of the human body. In a state of oozing out of perspiration, or what is called moisture on the skin of a person, all over him, which it is allowed (if my recollection is correct) vents and discharges half or more of all that we eat and drink daily.

It would surprise you to see this floating all over you, in a state of health, like water over a piece of watered meadow.

This salutary perspiration is commonly obstructed, and the skin becomes dry by what we commonly call catching cold. Its first symptoms are a stoppage of the nose, sneezing, and frequently a little dull headach.

But if the cold is suffered to continue, and the perspiration remains obstructed. The lungs will be soon affected. Or the headach will perhaps become violent. Or a lap or griping in the belly will most likely take place, and sometimes a violent vomiting with it; or a fever of some sort. The weak and the strong are all the subjects of this kind of the beginning of diseases.

All this evacuation is by the perspiration being obstructed thrown back upon the blood and intestines. Now all this mischief may easily, or commonly be prevented if when the simptoms are first felt, or you have reason to think that you have taken cold, you will pursue the following directions.

Drink sage tea* copiously and go to bed—and drink it, hot or cold, but not very strong, until you bring yourself into a little sweat, then go to sleep and you may expect to wake up well. But if you have neglected a little too long, take a pill No. 26, and go to sleep but dont neglect the tea. If that do not cure you try No. 29, and some physic, perhaps such as No. 1, 2, or 5. If the stomach or bowels are affected: or pain or inflammation takes place any where.

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* Or any other warming, sweating tea will do—such as pennyroyal, mint, sassafras or dogwood buds.

MEDICAL PRESCRIPTIONS.

No. 1.

The home Ipecacuanha, or *Indian physic*,

is an emetic, but commonly operates also as a purge. It is always safe, if moderately taken. After discharging the bile, it leaves the stomach braced, so that in the lowest cases of debility, tonics (such as Columbo root or its preparations) may be taken after it to advantage. Contrary to other physics, I have found that weakly persons, who were of mere broken constitution, have become healthy and strong, only by taking this to vomit them on every occasion.

This is my great pioneer to clear the way for other medicine, in all cases of oppression in the breast, nausea, violent vomitings & fever in general.

To use it moderately—take a pugil, or what you can grasp moderately with the thumb & fore-finger of the green root, four inches long, or the like quantity of dry root, make it into a decoction (say half a gill) and to a grown person give one third of it at a time every ten minutes, and if it does not work there is no harm done; but I chuse to continue it until it does work up or down. Cool water may be drank during its operation, only quench a coal in it, if you begin that way; gruel may also be given, so as to keep something in the belly. Should its operation be too fierce, a little laudanum may be necessary; for if the dose of the ipecacuanha be too large, it is a lion, otherwise a lamb.

This Ipecacuanha is a very bitter root. In a good bunch the green root will frequently be as big as a goose quill, is quirly and lumpy. The roots adhere in all sizes to a common root. The top and leaf resemble a bunch of close set briars, but smooth. The sprout for the new growth very much resemble the briar sprout. Many stalks grow to a good bunch two feet high, full of branches. On the top of which are very many lived whitish blossoms. They issue in small nubs or squareish pods, about the size of a buckwheat grain. It grows plentifully in many of our mountains in America, and I believe may be cultivated in our gardens, any where in the United States.

I have raised by planting the sprouts in my garden to great advantage. I wish it to be planted in every man's garden; 'tis a great ornament—it will grow either from the seed or the sprouts. One hill from a single sprout, when three years old, I have found to make half a pound of dried root. What a pity this should be neglected—as it has been sufficiently proved to be fully equal if not superior to the imported. Ipecacuanha of south America. It makes a most excellent and wholesome bitter when put in spirits.

No. 2.

The Scurvy Grass root,

is a special good purge. The stalk and leaf is rather of the flag kind, from six to ten inches long, has a small blue blossom on the top, issuing in a foursquare pod, full of small seeds like tobacco seeds. The roots are fine as Virginia snake root, of a pale yellow colour, and taste very hot and peppery, turning the lips and tongue yellow. It is found very plentifully in Virginia, and the southern states. And it is sometimes to be found in meadows, in Jersey, Pennsylvania and the Ohio states. The top is so hardy as to live thro the winter.

I have planted this in my garden for a number of years past, in the manner of shives, and from a single stool find it increase in two years to a bunch enough for several portions of physic. This can easily be procured from its spontaneous growth in the southern states. The green roots are to be made use of, as the dry will not purge. A pugil of the roots made into a decoction, and given at two draughts at 15 minutes distance, may be given as a common purge for a grown person.

Its operation is tolerably quick, always safe, and if it fails working, it does no hurt.

This little native of the woods was shown to me by old Dr. Wilkey, of South Carolina, who highly commended it; saying that he had known more sudden and effectual reliefs from it, than from any other medicine.* This I have abundantly used for 33 years, without regretting that I had made use of it in a single instance. From my own observations of it as a purge, the idea is impressed upon me, that the waters drained off by it take with them that viscid quality which is the cause of inflammation and pain. Poisons, errors of corrosive sublimate, inflammatory cases, &c. such as pleurisy, are speedily relieved by it; and cases of the contrary diathesis, such as costiveness, cholics, cramps, pains in the stomach, bowels or limbs, &c. can receive no better remedy.

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*I remember that Dr. Wilkey related to me the following fact: said he—"I was one morning very early called to visit a woman who had taken a dose of corrosive sublimate (in mistake, thinking it was tartar emetic) when I came to her, her tongue was so swelled that she could not speak a word. I thought it was over with her, but I would try my little root (meaning the scurvy grass root) I prepared a decoction as soon as possible, and tho it was supposed she could not swallow, yet we tried one spoonful after another, and found it made way for itself.——And what was surprising, she was so soon relieved, that on that very morning the woman fried pan-cakes for my breakfast."

It is to be noticed, that if the skin is chafed with vinegar, and a small poultice of these roots applied, they will draw a good blister. When this is given as a purge, bracing medicine should follow it, such as No. 4, No. 5, or No. 9.

I have sometimes filled a phial with the roots, and then put on spirits, and given a teaspoonful at a time, where the system requires warming and stimulating.

No. 3.

Culver's or Brinton's root,

is a purge, and famous for the cure of the pleurisy. Its top is a weed growing two or three feet high, having leaves coming out of the stalk at joints, some three, some four and so on to seven at a joint, according to the age of the root; a white tasseled blossom grows on the top of each branch, frequently as long as one's finger.

Out of a common stool grow a number of pale yellow roots, about as big as knitting-needles, and taste very bitter. A large handful of the roots made into a decoction, is enough for a common dose.

This root is good for use when dry; it possesses much of the narcotic, and requires the patient sometimes to be roused to keep him from falling asleep during its operation. It may be powdered and used like jalap, generally as a purge.

My father, Hezekiah Smith, for the cure of the pleurisy, practised long with this root, and used to cure the pleurisy with amazing speed. I have found that the root No. 2 is fully as good, or better.—Bleeding should precede the purge, when the pulse beats hard, and the inflammation is high.

No. 4.

The Columbo, or Miami root,

is found in plenty in the Ohio and Kentucky states. This valuable production is several years old before it sends up its stalk. The leaves are very smooth and grow in bunches nearly as big as mullen leaves, but not so wide; the stalk is round as a musket barrel, and often grows six or seven feet high, having always four leaves at right angles growing at a joint; its seed grows in pods shaped like a horse-bean, and are much like parsnip seeds.

The Columbo leaves occasion sweat copiously, when laid to the forehead, and will commonly relieve the headache; and this relief will be found special in many other cases—to sweat away boils, inflammations, and even old chronic pains.

The Columbo root ought to be used as a bracing or tonic medicine; but it is both an emetic and a cathartic, if taken in large quantities. People who will keep this root by them, and only chew as much as their stomachs will easily take (taking it in substance, which is preferable to any other way) will find it a remedy for almost any complaint, especially gripings, purgings, cholics, and generally all pains of the bowels.

One of the peculiar traits of the Columbo root is, that it braces the stomach, if only two or three chews of it are taken, and the spittle or saliva swallowed, that a plentiful drinking of cold water will not hurt you—yet it will perhaps be the best means in order to a sudden and positive cure. This may be relied on in a cholic, or almost any sudden attack of disease—and if you have an insatiable thirst, so that one drink of water only makes way for another, then take this Columbo root until the thirst abates, and drink what cold water you please. But after the thirst is abated, then if you drink cold water as much as you can well force down, you will very likely cure the fever at once.

To finish the cure of fevers, it should be taken in some form, until health is confirmed. Such is the efficacy of this root, that when they who take it recover, they are indeed well at once, needing no other medicine.

Bitters made of this root, are proper to confirm health; and I believe that this root, or its preparations, is the best relief for the nausea and costiveness of a pregnant woman.

The use of this root will, I expect, supercede that of the Jesuit barks, and so fill their place that we shall need none of them.

This Miami-Columbo root is of a pale yellow, its taste is a mild bitter, but of a lower jist than the imported, allowed to be so by reason of the odds of climate, yet fully as efficacious as the other.

This root might be sent to market in great quantities from the Miami country.

Dr. Richard Allison, of Cincinnati, claims the honor of discovering this to be the Columbo root in our country, and to him I am indebted for my first ideas of its virtues.

After Dr. Allison had been informed that the Doctors in Philadelphia denied it to be the Columbo root, I heard him say "*I know the Columbo root as well as any of them—and I believe it to be the Columbo root.*"

No. 5.

The Butternut or White-walnut bark pills,

are a valuable purge, very easy and safe, to all persons under disease.

These pills may be prepared by boiling a kettle of the bark of the butternut tree in water, until you gain the substance of the bark, then strain the liquor and boil it down; when it becomes thick as syrup, take care not to burn it, but simmer it to a substance like hard wax; then put it by in a cup or gally pot, and make it into pills as they are wanted, for if the pills are made up, they will run together and dissolve in a little time.

This purge is preferable to any that I know, in a weak and debilitated state of the bowels. It may be taken in as small quantities as you please, for if they do not purge immediately, they act the better as a stimulus and tonic to the system, and will produce a good habit of body by repeating them every night, and this may be done for a month together.

This differs from all other purges that I know of in this—that your doses may be less and less, but other physic must have more and more, or it will not purge. Other purges generally leave the body in a worse habit, but this in a better. Its general ease and safety, and its answering in almost every disease, so that I venture to say the trial of it will never be wrong, make it a far preferable medicine to salts or any other purge, where repeated applications are wanted.

I advise to begin with one or two pills at night, going to bed, which may be swallowed in a little stued fruit or rye mush, and the doses may be increased a little every night till they purge; then take less and less till the patient is quite well. Try this for pain in the stomach, worms, colds, consumptive coughs, costiveness, laxes, hemorrhage, or what you will, all is safe.

Those who are exposed by attending the sick, or where fevers or fluxes are suspected to be infectious, ought to take the butternut pills as a preventative. Their nature, and the proofs that I have known, cause me to suppose that they will seldom fail to prevent such infections, if taken for that purpose as here recommended. Drenches made of a decoction of this bark may be used for horses that have the yellow water, or for cattle that have the murrain. I have heard of both being speedily and effectually cured by it.

No. 6.

The China Rhubarb root,

will vomit and purge both. The sprouts from which this root was first raised in America, are said to have been brought from China by Doctor Johnson, of Pennsylvania. It is raised only by planting the sprouts. The leaves are nearly as large as burdock leaves and are smooth as beet leaves; it sends up a stock and blooms plentifully, but always blasts.

The roots are long, and lie in different directions, much in the form of horseradish roots, of a redish colour without and within—the root will come to a good maturity in two years.

This I suppose to be a rhubarb of a superior quality. I have chiefly used it by compounding with other medicine. It is a great tonic, but requires to be given in small quantities at a time.

No. 7.

The Nine-bark root,

is found growing plentifully in the state of Ohio, and on the waters of the Ohio river. Its top is a straight stem, partly between the wood and weed kind, growing about three or four feet high, having a pith like elder (but there are no joints in the stalk like elder, to prevent running out the pith, of which weavers' quills are made) the roots grow nearly on the top of the ground, and an armful of them can be commonly collected as soon as an armful of the tops. Its situation is commonly near creek banks.

This root is said to be a great cathartic, but I have never proved it.

The Indians use a decoction of these roots for fomenting and poulticing, in all cases which require such applications.

It removes the anguish, and cures a burn beyond credibility; cases verging on mortification, fellons, swellings, rising of a woman's breast, &c. yield to its application beyond any thing else.

To apply it, boil the roots and make a strong decoction, then take of the liquor and thicken up a poultice with bran or Indian meal, this may be put into a little bag made of a thin cloth, and apply it as warm and as moist as will be agreeable; this may be repeated as often as you will, until the pain or inflammation is quite gone, or the wound or sore cured. Linen or cotton cloths dipt in the liquor, hot, and applied as warm as can be borne, and then kept close while the case remains, and so repeated, will be a good way to apply it.

No. 8.

The Square-stalk root,

and its leaves, are both medicinal. The stalk is square, nearly of the size and shape of the catnip stalk. It is a native of the soil, grows five or six feet high, branching out with two stems at a joint; its pods and seeds nearly resemble the tobacco; its leaves are beautiful and smooth on both sides.—The Porter's ointment is principally made of these leaves. The root when pulled up, appears tender and white like a white radish, branching in different directions, somewhat larger than a goose quill.—This root has frequently been used to make poultices for sores, but its chief use by the Indians is for women's complaints. Use it in tea or decoctions, which may freely be drank, being quite innocent, but very efficacious.

It is a remedy for pains attending the peculiar state, or purgations of females; it may be given both before and after child-birth; it will restore obstructed lochia, and briefly speaking, it is the best women's root that I know.

No. 9.

Agrimoney

is a valuable medicine, both the herb and the root. It is a tonic, or strengthener of the system, and affects most sensibly the regions of the kidneys and bladder. A tea or powder of this simple is a remedy for the diabetes, or involuntary emission of urine. I conclude it is very advisable to give it either as a tea for breakfast and supper, or as a diet drink, whenever we wish to promote nervous strength. The roots may be boiled in milk and water, and given in dysentery and other fluxes.

Culpepper's English physician describes and highly commends this herb. It is a native of the woods, but is friendly to cultivation. There are two kinds, the high land, and water agrimoney, it is the former I recommend.

It may be known by its little lonely stalks being strung with small yellow blossoms, which issue in small burs, it has a rough leaf, a little like a strawberry leaf, but strung out on each side of a stem in many divisions from the stalk to the tip of its point. It is of a rough-like taste, and scarcely bitter; the roots taste much like the tops, grow from the stool in a circular direction, are black, and large as knitting needles. The herb and roots may be used green or dry.

No. 10.

The Black Snake root,

is a purger of the urine and kidneys, and a dissolver of scorbutics.

A tea of it may be freely drank in a fever, a handful to make a quart of tea, and is a special medicine where there is soreness or aching across the loins. The yellow fever has been suddenly cured by this tea, the bile having first been moved by an emetic. It cures the bite of a snake by chewing and swallowing the root, and by applying it to the bite as a poultice, chewed or bruised.

The appearance of this root and its top is a good deal similar to the agrimoney, having a leaf more like the strawberry leaf, but smooth, and at full growth much larger, more round, and regularly cleaved like a five-finger leaf, and often as broad as a colt's hoof; when it ascends into a stalk with a spreading top, it produces at the extremities a bur a little larger than the agrimoney. This root is blackish, tastes earthy and aromatic, is situated regularly round its stool in every direction, in straight roots, a little larger than knitting needles.

The Indians cure the ague by sweating with this root. It is friendly to cultivation. It may be used green or dry.

No. 11.

The Corn Snake root,

grows plentifully in the prairies in the state of Ohio. I call it corn snake root, because its leaf resembles young corn, has prickly points all along on its edges, and a superior one at the extreme point of its leaf; it sends up a round stalk sometimes two feet high, with those prickly pointed leaves scattering along upon it; and on the top grows a round ball about as large as a musket bullet, covered thick with white bloom. The root consists of a knob about an inch long, the bottom being the largest, and appears always as if it was decayed or rotted off, there are small roots adhering round this stool or knob.

The taste of this root resembles the black snake root, but its taste very pungent, and is perhaps fifty times as strong as that.

The great use (as far as known) of this root, is to cure the bite of the rattle snake, or any other poisonous bite or sting. The root need only to be chewed and laid on the bite, and a little of it swallowed. If this can be done when the bite is first sustained, it prevents the place bitten from swelling. It is generally, first or last, a speedy cure.

As this root surpasses every thing we know of for the snake poison, and must pass thro' the secretions amazingly quick, moving the urine and perspiration, and is similar in taste and operation to the black snake root, but vastly more powerful, it becomes an object, cautiously to try it in the cases mentioned, and proved, of the black snake root, that is, in scrophulous and venereal complaints, the bilious, typhus or camp fevers, and in infectious diseases generally.

But it should always be remembered, that when these attenuating, dissolving, diuretic roots are used, they should be continued but for a short time, and then followed with bracing medicine, as agrimoney tea, Columbo root, or chalybeate oxymel, No. 44.

No 12.

The Mountain Mint,

is a large wild herb, of a very hot taste, grows frequently between two or three feet high, bearing a blossom on the top of its stem like a small rose.

A tea made of this herb has been found very effectual to relieve the gravel, and that when other medicines had proved ineffectual (but see for relieving that complaint No. 24.) The mountain mint may easily be raised in our gardens; and is generally speaking, a fine, safe, diuretic and perspirative medicine, when made into a tea.

No. 13.

The Horse Balm,

or as it is called by some, Clown Wounds Wort, Rich Weed, and Hard Root. The leaves are famous for raising sweat wherever a bunch of them is applied to the skin, and by that means give ease of pain in any part where they are applied. Apply a bunch of them to a stiff neck, bind them close, it will raise a sweat and effect a cure. These leaves thus applied to boils, softens them and eases their anguish, and frequently will carry them away when half grown. The same application will merit a trial in any inflammations on the skin, or more deeply seated in any part of your body, or the aching of your back, or any joint or limb.

The New-England people, I have been told, make an ointment of these leaves to put upon the necks of their oxen.

The root of these medicinal leaves is much like an artichoke, but of a wood-like substance; its stem is round and small, grows about two feet high, the leaves are notched like a hickory leaf, but wider and very smooth, its blossoms are yellow, it has a delicious smell. It is a native of the woods, but will be soon eat out where stock run. It will grow well in the garden.

No. 14.

The bark of the White Pine,
is a great medicine for sores. It should be boiled, and the soft part stript out and beat to a poultice in a mortar, and then sufficiently moistened with the liquor and applied to burns, or sores of any kind. Repeat the poultices and wash with the liquor until the sore is well. This will not terrify or smart in its application; a new skin will come on quickly, without a scar.

The same application is a cure for the piles. A little tea of the bark should be drank, while the external applications are continued. As this bark cannot always be had, it would be desirable that an essential oil should be made of the white pine, or an essence of the bark and limbs, which if mixed with water in a bottle, and applied with a feather, it is conceived would answer in place of the above application of the bark.

No. 15.

The Abela, or Trumpet-weed root,
is a fine stimulus, and promotes excitability in cases of numbness, and want of sensibility in the feelings, which follow fevers, or may otherwise exist. Two drachms of the dried root, or a pugil of the green, may be put into a pint of spirits: a teaspoonful or two at a time may be given three times a day

when the stomach is most empty, in a little tea, and a little nourishment may follow in a few minutes. It should be continued, increased or omitted, according to its effect on the patient.

This root the Africans give to make the wenches amorous and fruitful. It is supposed to excite venereal desires.

The Abela, or Trumpet-weed root grows plentifully in the southern states, and some of it I have found in the Miami country. The leaf is large as a horse's hoof; the stalk is round, and grows five or six feet high, having a scatter of leaves, one at a place, on the stalk, which is guttered like fine dimity, of a rough and russet appearance; the show of its blossom is much like the cotton weed; the roots are remarkably small for the size of the top, consisting of a stool as long as one's finger, to which adhere a number of small brown roots, not much larger than knitting-needles: the taste of these roots is mild and spicy, but becomes pungent in a minute or two.

No. 16.

The Blue-berry, or Sore throat root

is a very pungent aromatic. The stalk and leaves much resemble the squaw root, but are more slender and nice; it grows about knee-high, & is divided regularly into three branches, and then subdivided in the same manner. It bears a few berries on a middle stem, which when ripe are blue, and rather larger than a blue whortleberry. The roots adhere to a stool, and form a great bushy bunch; the fibres are not much larger than Virginia snake root, and are very strong and severe in taste, but leave a sweet and agreeable relish at last. See No. 48.

A tea made of the blue berry root, when it comes to be known and proved, will probably be esteemed as the best antispasmodic in the compass of medicine. That is, it will prevent and do away spasms of every description in a safe and superior manner. By spasms I mean involuntary contractions—such as cramp, hiccup, cholic, cholera morbus, epilepsy, hysterics, and I suppose every other species of fits, even the ague.

Should the blue berry root be wanted abroad and in the shops, the state of Ohio can furnish great quantities of it for market.

The blue berry root is said to be the great medicine that the squaws use at the birth of their children. Experience has however proved, among white women, that its assistance is very special. It is to be made use of in the following manner—Take a good handful of green or dry roots, make it into a tea (say half a pint) give the half of it, and fill up with hot water; repeat the drinking every 10 minutes, or oftener, until it has its effect.

When a woman finds that she is taken in labor, let her drink as above, having her help at hand—if it is not her time, she will probably get easy and be well; but if it is her time, expect the delivery will be facilitated with much safety. It is to be noticed, that if the anguish attending the delivery is not moderated, the doses have not been strong enough; for they act on the same stimulant principles that opium does—and a suitable degree of indirect debility will moderate the great distress that must otherwise be experienced. The delivery is facilitated by it, so as seldom to be slow and lingering. But the great benefit is the state of safety and of speedy and sure recovery that the mother experiences afterwards.

The squaws, I have heard, drink a little of a tea of this root for two or three weeks before their expected time. I have given this tea in a case of inflammation of the uterus, and found it a. speedy cure.

The tea of this root is neither a purge nor a vomit, but acts as a stimulus to the nervous system, till by indirect debility it will give ease in any distress. I believe that it is always safe.

No. 17.

The Squaw root,

is also called Rattle weed and Black Snake root. Its stalk is parted regularly into three branches, which support nice leaves at about two feet high, but the stalk that goes to seed is often four or five feet high, strung towards the top with white blossoms, which terminate in a jumble of pods filled with fine seed; adhering to the stool is a great bunch of small black roots: these roots are purgative, make a good bitter when put in spirits, famous for curing the chronic rheumatism, and strengthens the system when moderately used. See No. 48 and No. 65.

I have heard that this root is famous for the cure of a snake-bite. The root is to be applied to the bite in a poultice, and a little taken inwardly.

No. 18.

The Back-ache root,

is, I believe, the same that is called Devil's bit by the New-England people. It grows plentifully in the prairies of the Ohio and western country. The stalk is a round weed about three feet high, lightly strung with long leaves, and towards the top arises a kind of tassel of purple bloom. The root is a knob much like the corn snake root; its taste is mild and spicy, but with all resembles the taste of a pine bud.

This root, if made into a tea, is said to promote a gentle sweat, and cure the backache. The croup, or bold hives, used to be speedily cured in New-England, I have been told, by giving this tea, and taking a handful of these roots sliced, hot out of the decoction, and binding them to the child's breast.

No. 19.

The Devil's nip,

as it is shamefully called, grows about knee high, parting its stalk into three branches, on which are situate handsome oval pointed leaves; on a slender middle stem grows one handsome flower, resembling a lilly, some of which are white, and some of a pale pink color. The root is a knob; the whole resembles the well known Indian turnip, but the root is more conical; its taste is too severe to be endured, but not biting like the Indian turnip. It is said, that any person carrying a root or two, need never fear that any snake will bite him. A little of it put in the mouth of a snake, is instant death to him.—A German doctor used to give it to persons deranged and announced their cure by it. Its stimulant qualities are certainly rare.

No. 20.

The Devil's bit,

like the foregoing, has an ill name, but is a good root. This is, in some places, known by the name of Star root. It has a small round stalk, about nine inches or a foot high, scattered round with little leaves, resembling corn leaves, and has a white tasselled bloom on the top; the root is conical, being a knob about an inch long, largest at the bottom, and appears as if it had rotted off.

This root is a delicate nice bitter, and of a tonic and bracing nature. It is said to be excellent for a sore throat, and is one of the ingredients in a former celebrated preparation for the choaking quinsy. It has been called Maiden's Relief, because when used in tea, it relieves from pains and distress which are peculiar to the fair sex. It will help with dogwood and wild cherry bark to make a very pleasant and wholesome bitter when put in spirits.

No. 21.

The small Asmart,

if dried, makes a tolerable and very wholesome tea. It has been used by persons troubled with the gravel, or otherwise passing their urine in distress, to their great relief.

It is amazing to see how plenty this invaluable remedy grows in our country every where, and how few know and respect it. A tea made of this herb would probably cure a cough or cold in a special manner, and will always be quite innocent. The herb is so common and so well known, that I need not describe it. I will only add, I have drank it myself, and know what I have here written to be true.

I conjecture that the asmart tea would destroy and expel worms; but the thought is new with me. I recollect that I once saw some boys catching fish in a little pond where they had previously scattered asmart, and in a little time they had the fish floating dead on top of the water.

No. 22.

John's Wort,

is a valuable herb, and should be cultivated in our gardens. It is so generally known, that I hardly need to describe it. But I will just say—the tops of its branches grow full of little yellow flowers, and contain its seed in small knobbed pods, not much larger than buckwheat grains. It is a native of the soil, and grows in all parts of our country. (But it should always be noticed, that what I here commend, is not that noxious weed which grows in old fields, and causes sores and scabs on the horses noses that are white.)

A tea made of this herb, relieves the lungs and breast, when respiration is obstructed, especially if joined with sage. Ointments and Oils prepared with it, are delicate and valuable, and may be applied to a fretted skin, a galled groin, a swelled face, &c. See No. 47 & 48.

No. 23.

Eye-water,

first prepared by Doctor Elijah Reeder.

To make 3 gills—take a spoonful heaped up of white vitrol, and the same quantity of common salt, calcine them together on copper, or a piece of earthen, on coals, stirring it with a stick, until it becomes a grey powder; then put it into a bowl, and add to it three gills of rain water. Strain it thro paper, or a fine rag two or three double—then add two table spoonfuls of white sugar and a lump of blue-stone, as big as a large grain of Indian corn, and bottle it for use. Three times the quantities will make a bottle, or quart. Remember, no iron or pewter is to be employed in the process. This eye-water will keep good for years, but beware of frost, lest you loose your bottle. This eye-water cures the western country sore eyes, which are scarcely, if ever relieved by the old eye-waters. This eye-water I have kept and used these fifteen years, with the greatest success, and without a single complaint of its doing hurt.

Throw a drop or two of this eye-water into your eye out of a silver teaspoon, and repeat it often, if your eyes are bad; or wet them with your finger, and you will find, commonly, that the inflammation will soon abate, and the eye will bear it better and better; and then you may prolong your times to two or three times a-day, but continue to use some till your eyes are quite well. This eye-water will scarcely affect a well eye at all. It cures old sore eyes of drinking people—but a gentle purge, and sometimes a blister, in highly inflamed cases, have been necessary.

No. 24.

Dr. Perkins' last remedy,

is prepared by taking a small quantity of good vinegar (say two table spoonfuls) and dissolve common salt in it as long as it will melt; then take a table spoonful of this mixture, put it into a teacup, and add four table spoonsful of boiling water, and as soon as it is cool enough, it is to be drank. Or it may be taken gradually; and respect should always be had to the age and strength of the patient. This is recommended in obstinate fits of the cholic, dysentery, and in all cases where pains are occasioned by obstructed perspiration. I have given it in obstinate vomiting, dividing it into three doses, and giving it at ten minutes distance, and when thrown up, repeating it until it did stay. The whole surface of the body being cold, became warm, and the patient lived, when probability said he must die.

No. 25.

The Columbo Root Oxymel.

To prepare—

When our Miami root (No. 4.) can be had green, slice up enough to fill a tin cup; put it in, and cover it with good Vinegar, and stew, and fill up, until the root will yield its strength to the liquor. Then strain and wring it out, and return it to stew: then add a teacup of sugar and a gill of spirits: then simmer it down to molasses, and bottle it for use.

The process with the dry, or the imported root, will be easy; and larger quantities may be made by proportion.

This oxymel may be taken hourly for three or four hours, a teaspoon full at a time for a grown person, in extreme cases, or until ease takes place: after that three doses in twenty-four hours is commonly enough.

In the rise of a fever, it may be given sparingly or in small doses, but when a remission or intermission takes place, it should be taken more liberally, cool water may be drank plentifully, in all cases, a few minutes after taking the oxymels. The third will undoubtedly abate, by the oxymel being thus taken; but then, a plentiful drinking of cold water will greatly facilitate the cure of a fever.

Respect should be had to the strength of the patient; for excess or indiscression may occasion indirect debility; but a long continuance (at times omitting it) will never do hurt, but is always calculated to promote health and strength.

Give it in cases of nausea, diarrhoea, dysentary and costiveness. The last will be relieved in two or three days without any other medicine.

It is calculated to brace the system, especially the stomach and bowels, acting principally upon the nerves: and where this is used, barks and wine may be omited.

Nothing can be better to relieve the sick qualm and costiveness of a pregnant woman.

No. 26.

Anodyne Pills,

for the cholic, hysterics, &c.—Take half a ounce of opium and one ounce of asafœtida, rub them in a mortar, and moisten them with a few drops of spirits, till they form a mass of pills. This may be put by in a roll, and made up as they are wanted. A pill of a common size should be given as early as possible, when a cholic is approaching, and if in one hour the symptoms do not subside, repeat the pill hourly till ease and drowsiness takes place; for the exact dose can never be known but by this sparing hand procedure; but one pill will be a cure nine times out of ten.

The hysterics, and all spasms and cramps, especially of the stomach, may be relieved the same way.

Children that suck, have often taken this to quiet them and cure their belly-ache; a pill as big as the head of a pin is commonly enough for a child six months old. This composition is such as to flux the opium, that its killing power seems to be laid aside; and a person may safely take four times as much opium in this state, as they might otherwise dare to take.

This pill I have always found to be laxative, and slowly operates in that way in the course of 24 hours. I have carried these pills with me constantly for more than twenty years, and tried them instead of laudanum, on almost every occasion.

A child in my neighborhood was obliged constantly to take these pills, twice a-day for six months, and increase their size; he throve well upon them, and finally they overcame his spasms, belly-ache (and otherwise continual crying) and after awhile he could do as well without them as any body, and is now a stout hardy boy. This child doubtless partook of the affection of his mother, who was dreadfully affrighted before he was born.

No. 27.

Dr. Reeder's chalybeate, for female weaknesses.

To prepare—take three quarts of strong vinegar, two ounces anvil scales, pounded fine and the dust blown out, one pugil of Virginia or Seneca snake root, one pugil of mountain ditny or garden ground ivy, simmer them together in an iron pot to a pint; then strain the liquor and return it into the pot; put into it ten grains of myrrh and ten grains of aloes, a pound of sugar and a gill of spirits; cover it close, and simmer it down on coals to thick molasses, and put it by for use.

A teaspoonful is a dose, night, morning and night; then miss the like times, and take it again; and so continue the course till nature is braced & strengthened. This is a cure for obstructed menses, or wasting fluor. See No. 44 how to give it.

With this medicine many have been relieved: the barren have become fruitful; and those despairing of life, have been restored to health by taking this.

The prescriptions No. 25 and No. 44 were devised after the pattern of this, for which I am ever indebted to the friendship of Dr. Elijah Reeder, of Franklin, on the big Miami.

No. 28.

Warner's blood-purging pills.

To prepare—take one pound of ipecac. No. 1, of dry roots, or two pounds of green roots, four pounds of green horse radish roots, and two inches of blue flag root; put them into a pot and boil them in stale cider until you gain the strength of the roots; then strain and wring out the liquor; boil it down to a quart; then add half an ounce of aloes and half an ounce of myrrh, and simmer it down to a mass for pills: then put it by for use in a vessel or galley pot.

This kind of pills, my father used to make and keep in my day of living with him, and long before I was born. He used always to sell them at three prices. He used to give them in his cures of old ulcers, and sores, frequently two or three times a week. Those who took them said they generally made them hungry.

I believe they give the blood a lively circulation. I have given them to my patients inoculated with the small pox, a few hours before I expected the fever, having given nothing before it; the effect was favorable, beyond all expectation; for they then had little or no fever at all.

Three or four pills of common size, is a common dose; it is expected only to be a slow purge, but it will sometimes puke a little. Take care to give little enough, and you are always safe.

No. 29.

Porter's ointment.

To prepare—take four pounds of square-stalk leaves, No. 8, two pounds of elder leaves, and one pound of catnip leaves; beat them well in a mortar and mix them up in fresh butter or good hog's fat, put them in a brass kettle or an earthen pot, and heat it or stew it moderately, keeping grease enough in it to cover the herbs; keep it about the fire, and simmer it at times for a week; then wring out the ointment, and put it by for use.

The *Green Ointment*, or tent salve, is made by taking of the above ointment and Venice turpentine, of each half a pint; put them in a saucepan or some suitable vessel, not iron; add of blue stone the size of two grains of Indian corn, and the same quantity of verdigrease; both are to be powdered and stirred in: the whole is to be boiled or simmered on the fire until it looks like green glass. This tent ointment cleanses ulcers and old sores to the bottom, and keeps out proud flesh or fungus. My father used to say it would scrape a bone. The cure may always be looked upon as sound, where this is used.

The first ointment is to be used for fomenting benumbed and withered limbs. Such have been often restored by it, when many other applications had failed.

Sores are to be anointed with this first ointment, around, even when the tent ointment is put in; and it is very excellent to anoint a woman's sore breast.

No. 30.

The Red Lead Sear Cloth Salve.

To prepare—take three half pints of Sweet Oil, or in case that cannot be had, take the like quantity of fresh butter when boiled & skimmed; one pint of Linseed oil: boil them in a skillet, so hot that it will burn a feather; then add one pound of pulverised Red Lead to be stirred gently into it, while hot, (but the oil must be somewhat cooled or it will foam and run over) until it becomes like soft wax.

This is to be spread on thin leather, and applied as a Sear Cloth or Plaster; which is not to be taken off, until it comes off of itself. If matter should gather in a sore, it must be let out by an awl through the plaster.

This plaster I have heard was formerly in the possession of a German whose name I do not recollect, who lived latterally in Kentucky. He performed many astonishing cures with it. I saw one of his patients, who had been wounded at the Germantown battle, 1777, in the Revolutionary war; one of his legs had been broken and shattered, while he was one of the forlorn party sent to tear down the fence and palings about Chew's house. He told me that due care had been taken in setting the bone, and trying to cure the humours, but all in vain, he had to endure grievous sores, every application being of little or no avail; until in about twenty years, he fortunately fell in with this German, who by the means of this plaster, cured his leg. It was then sound and well, when I had this story from his own mouth.

Since the secret has been disclosed, I know families who keep it and use it on all occasions, and speak in the most absolute terms in its praise.

Before this disclosure, there were people who would have paid twenty dollars for this receipt, as willingly as any of you would pay twenty dollars for a horse worth an hundred.

Put this plaster to a fresh wound or cut, it keeps all close, and you have no trouble with it as a gaping, freting and running sore.

No. 31.

Common Salve,

May be made by taking Horse balm leaves, (No. 13.) Burnet, Mallelet, Spikenard Root, or any two or three of them; beat them well in a mortar, and stew them in tallow and fresh butter, equal quantities; and when you get the strength of the herbs, strain and ring out the grese, and add equal quantities of Rosin and Castile Soap, until your salve becomes a right consistence.

No. 32.

Wild Pursley Ointment,

There is in our western country, near our creeks, on places overflown in high water, a little wild Evergreen, much resembling Pursley. It is one of the Indian medicines for Snake-bites, and other poisons; they use it inwardly and outwardly; but when an ointment or salve is made of it, I have found it very cool and pacifying to freting, smarting sores; it is the best for blistering humours, of any thing I have ever tried. I have proved it on sore lips and other inveterate smarting sores.

A little Tar put into this ointment will add to its excellence.

No. 33.

A Tent Salve for Fellons,

May be made, by taking equal quantities of Brimstone, Bluestone and Allum; rub them in a brass mortar, and when powdered, moisten it with spirits, honey and white of an egg, mixed, equal quantities; rub all together fifteen minutes with a brass pestle, and make it of a right consistence.

The property of this tent salve is to destroy fungus or inflamed flesh, by turning it quickly into matter; and if followed up and attended rightly, it will bring out the core, and get to the bottom of any rising in two or three days. Cancers may be destroyed and eaten out by it.

This will answer all the ends of what is called caustic, with less anguish.

No. 34.

The Tooth-ache, to cure by Sympathy.

The process—The patient is enjoined not to narrate what is done to him, or the Tooth-ache will return, (but a repetition will restore the cure.)

All the finger and toe nails are to be trimmed, the pieces off of each are to be laid on a rag or paper; to which also is to be laid a lock of hair taken from the head; then the gum of the tooth is to be gouged or pierced, to add some blood to the nails & hair; then the whole is to be wraped together in the bank of some creek or gulley, at a place where no creature crosses. The operator may keep the putting away to himself, if he pleases.

Indians they say have queer notions. Hah! but I have tried this for perhaps fifteen years, on myself and many others, and seldom without immediate success. The tooth, it is believed, when it becomes easy, will never ache again.—If the pain remains, chew root, No. 2, or No. 16.

If you are willing to try this, you may rest assured, it will do you no hurt.

No. 35.

The Ear-Ache,

Will often be cured by the application of Spikenard Root. Take the green Spikenard Root, beat it and add a little water to moisten the root; then squeeze out the juice and put it into a phial; drop this into the ear, morning and evening, a drop or two at a time, and continue it as long as you please.

This is likely to help a deaf ear, if any thing will, and is a real Indian cure. The Oil of Spikenard, used in like manner, might perhaps be better than the above.

No. 36.

The King's Evil,

Has I know been cured by the Pond Lilley Root; I mean those of a slender stem, a floating leaf, shaped like a horse's foot; often growing in water eight or ten feet deep; the Lilley is the most delicious, also floating on the water, held by a slender flexible stem. The root is knotty and oval, like a Calamus root, and as large nearly as a chair-post. This root should be boiled, beat soft in a mortar, and moisten to a poltice with the liquor; a little of which should be drank morning and evening, and the poltices repeated.

These boils and risings in the glands of the neck, called the King's Evil, have been also digested and cured, by applications of green Frog-spawn, taken out of springs, and applied as a poltice.

I would recommend the root and bark, No. 7 and No. 14 to finish the cure.

No. 37.

Cold Water Applications,

I reckon among the choicest of my discoveries.

The following I recommend:

When the accident of a bruise, piercing of a nail, a cut, a broken bone, an eye knocked out and put in again, &c. takes place, immerse the part in cold water as quick as possible, and then dip a large soft linen cloth into cold water and apply it, and keep out the air. This cloth should be kept close; aid this by dropping cold water upon it for fifteen minutes, and continue it close for twelve hours. The inflamation by this means will be kept back, and the cure by any thing else, will be almost forestalled; and then a bruise, a strain or broken bone, will scarcely swell at all; and a like application to a burn will have a similar effect. In about fifteen minutes the first pain will be over, and the future ease will be stedfast.

I have tried the foregoing applications of cold water, with full demonstrations, for forty years past.

No. 38.

The Poor Man's Medicine.

Boil four ounces of pure Quicksilver in an iron pot, with two quarts of water, until half is evaporated, and bottle the water for use.

The same Quicksilver will serve, again and again, as often as you want a fresh supply of the water. This medicine is said to be as simple in taste, and as safe in using as so much simple water, and may be drank as often and as much as you please. The virtues are many: it may be used externally or internally; it destroys worms, purifies the blood, opens obstructions, scours the glands, cures all impurities of the skin, ulcers, scald-head, &c.

The yellow water in horses, we have often cured, by boiling only one ounce of Quicksilver in a large pot of water; letting the horse drink a gallon at a time, or mixing his feed with the water; continuing the course for about ten days, and boiling the Quicksilver again and again; and I have found them cured, of imposthumes, following the throat-distemper, by the same means.

No. 39.

A Sweat of Virginia Snake Root and Sage Tea,

Is one of my old remedies for fevers.

Take one drachm of Virginia Snake Root, and make it into a decoction, say half a gill; let the patient drink it and cover warm in bed; then have ready a coffee-pot of weak Sage Tea, say three pints; let the patient begin to drink in ten or fifteen minutes, as warm and as much as he can, out of the spout, not rising or uncovering.—By this drinking keep up the sweat for four hours; then cool moderately and take care of all exposure and excess for the first twenty-four hours. Follow it with No. 9 or 25.

This sweat I have often given (after a puke or purge) in obstinate fevers, such as the nervous, the intermittent, the fever and ague, &c.

I have used this sweat in old second or third day agues, always with success. I have chosen to begin about an hour before the ague, and take up the hour of ague in the sweat. In other cases, I have chosen the wellest time, and never omit it when pain or sickness attend the rise of a fever.—Chips or blocks of wood taken out of a pot of boiling water, may be wrapped up and put in the bed with the patient, to set the sweat agoing.

This sweat should be repeated again, after two or three days, if there is not manifest signs of recovery.

Such a sweat has appeared to me, to move off the obstructions to a right circulation, and to take away the very offending matter out of the blood.

Persons very weak, and especially those who have pain in any part of the body, or all over them, ought to try this. But it should always be followed with bracing medicine, such as the above cited or No. 4. Dont omit, even if the patient seems fairly well by the sweat.

No. 40.

To cure the Jaundice.

1. Give the Emetic No. 1.
2. Give the Pills No. 41, every night, what the stomach can bear.
3. Make a diet drink of wild Cherry bark, and use it constantly till well.

4. If the case is obstinate, give one dose of No. 24, to move the perspiration.
5. Then save the urine, (say a pint) mix it into a cake with rye meal, and burn it slowly behind the back log twice or three times, (per sympathy.)
6. Give Chalybeate Oxmel, (No. 44.)

Doctor Hole relates, that he was cured of an obstinate habit of the Jaundice, into which he had several times relapsed, and which he had proved on others for twenty years, with the most happy success. The process is as follows:

1. Put wild Cherry bark into stale cider, (say a double handful to two quarts.)

2. Take the scale that forms on an old chimney back-wall, or on an old iron tramel, (scrape off a good handful) and make a decoction.—Drink turn about of each of these, five or six times a day, as much as the stomach can take, and follow it up till the cure is perfected. Probably there is a good portion of Oxigen in the scale that is generated by smoke. See note, No. 44.

You can have choice, and if one thing wont do, try the other.

No. 41.

Pills for the Jaundice.

Take three ounces of China Rhubarb, powdered (No. 6) one drachm of Myrrh, and one drachm of Alloes, rub them fine, and put altogether, and moisten it with spirits to form a mass of Pills. They must be made up soon, or they become hard. I choose always to keep some of this preparation by me in a roll; I can then put some of it into a phial of spirits, so that a tea spoonful will be a dose. This roll will make excellent bitters, will be an antidote against Dysentery, excess of Bile, the Jaundice, &c.

A little matter of these pills, will answer to relieve costiveness; they answer best, gently or gradually taken; they will then strengthen the system. In this they will be good in Diarrhoea or fluxes, but are not equal to No. 25.

No. 42.

An Antidote for Epidemic Diseases.

Prepare you a few Brimstone matches, and a bottle half full of spirits; light a match and thrust it into the mouth of the bottle, so as to fill the empty part with smoke. When the match is taken out, put your thumb on the mouth, and shake the spirits, to incorporate the smoke what they can. Do thus with several matches.

This I had from a very old man, when I was but a little boy. I remember he said, a dram of this rum will keep you from catching the Small-Pox or Meazles; yes, if you will drink a dram of this in the morning, you may go safely where the plague is all day. But I rather suppose it had better be taken morning, noon and night.—I tried it myself before I had the Small-Pox.—See Antidote, No. 5.

No. 43.

Huron's Cure for the Dropsy.

Take Bitter Sweet Root, White Roots of Elder, Horse Radish Roots, of each a large handful, steep them in one gallon of Cider. Take a tea cup full in the morning, and always before meal times through the day.

In a very weak case, a jelly of calf's-feet is to be eaten cold, with vinegar. If the stomach rejects food, a little Elixer of Vitriol made into punch, may be allowed. Diet is not to be high seasoned, but any kind to be liberally used, that the stomach will take. This medicine may be prepared with Vinegar, or even with water where cider can not be had. This receipt came to me well attested; by it was performed several singular cures, after patients were given over by physicians for lost.

A single instance experienced but in one trial, from a child of my own I wish to relate.

My youngest daughter, when about two years old, lost her appetite, became uncommonly disposed to sleep, her sprightliness turned to stupidity, and in a few days she became bloated and apparently filled with water or dropsical swelling in her whole frame; and as I could not conceive how I could administer any means of relief to her by any thing I could give her internally, I studied to endeavour it by an external application.

I took Horse Radish and Spiknard Root, (two diureticks) equal quantities, pounded them in a mortar, green, and applied them by way of poltice to the bottoms of her feet. The wished for effect, a plentiful emission of urine took place, & cleared the dropsy in about forty-eight hours. I gave her a few doses of Linseed Oil, agreeably to No. 55, and she soon became well and hearty.

But try the following (No. 44) for the Dropsy.

No. 44.

Chalybeate Oxymel.

Take two ounces of Columbo Root,* one drachm of Virginia Snake Root, twenty tenpenny Nails, and one quart of good Vinegar, put them together in an iron pot; simmer it a little over fire; then let it stand forty-eight hours; then boil it down to a pint; strain and wring out the liquor, and return it into the pot; then add one pound of sugar and a gill of spirits; simmer it down on coals to the consistence of molasses, and bottle it up for use.

The common dose for a grown person may be a tea-spoonful, morning, noon and night, when the stomach is empty, about ten minutes before meals; but begin with less, and increase the dose, as you find the stomach can bear it.

The intention of this medicine is to recruit the blood, and strengthen the system. It may be taken a week, and then miss a week; and then take it again; and so at intervals renew the course, more or less, until the patient is quite well and strong.

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* The Columbo Root, if left in whole pieces, may afterwards be strung and dried, it will then be good to chew, or to be used instead of barks.

In consumptive cases the person should drink ground ivy or agrimoney tea, for two or three days at a time, and then miss as long, and then resume it again. The latter of these herbs is preferred for bracing and giving strength, but the former is conceived to touch the disorders of the liver.

This medicine will be found a superior remedy for worms, as those vermin cannot live with the iron. It is most excellent for the weaknesses of women, either under suppressions, or in excess of the fluor of either kind. But when it takes place, the doses should be omitted until it subsides. It may be given to finish the cure of fevers in general. It merits a trial in all reduced and low cases of the blood, such as consumption, dropsy, asthma, jaundice, derangement, &c. to recruit the oxygen,* or iron property in the blood; a deficiency of which, as I conceive, is the radical cause of these diseases.

Healthy persons have a right proportion of oxygen; but an excess or deficiency may either of them be the occasion of disease. The excess of oxygen* is not so much to be feared, and occurs but seldom; but deficiency of oxygen happens very often, and I expect always in consumption, dropsy, jaundice and palsy; but I leave it to future observation more accurately to determine this. I have however observed, that blacksmiths, or those working in iron, seldom if ever have the consumption or dropsy.

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* Take notice—There is a certain part of our bodily substance that I call oxygen, or iron; this is the basis of strength. There is abundantly more oxygen in the blood than in any part of us. When blood is taken in a vessel and stands to be cold—1. There is the clods, or viscid, tenacious part, called the grume: 2. The thin and watery part, called the serum. It is said there is much more iron in the serum than in the grume.

A late patient of mine, who had been a year or two in a state of melancholy, told me that the electrical machine had been tried on her, but the same charge that would shock other people hard, had little or no effect on her. I leave it to those who have opportunity to observe, whether the electrical shock will not be the same in the cases of consumption, dropsy and jaundice; and whether it does not announce a deficiency of oxygen.

But the great question with me is how to restore the oxygen in a consumptive person; iron or a preparation of it being my alternative. Two things I fear—1. An increase of the pulmonary, or pain in the breast; 2. Bleeding at the lungs. My prescription No. 44, I conceive will not expose the patient either as to pulmonary or bleeding at the lungs; but will gently increase the oxygen, and innocently prepare good blood: the issue will be a recovery to good health, if such a thing be possible.

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* I have noticed that blacksmiths are very subject to rheumatic pains: the cause, I conceive, is an excess of oxygen: and this may most generally exist with, and be the root of the diathesis of plethora and irritation. The remedy most probably will be No. 39 and 72.

My children and friends—after you look over this, when you see a person with a white face, male or female, you will be ready to say "*That person wants Father Smith's chalybeate oxymel*" No. 44.

No. 45.

Dr. Tiffin's prescription for derangement, or mania.

Get gum myrrh, asafœtida, aloes and castor, of each a quarter of an ounce, opium and camphor one drachm each; powder them separately, and mix them all together with oil of amber sufficient to make them up into pills the size of garden peas. Get at the same time two ounces of Peruvian bark, red or yellow, and half an ounce of rust of steel; mix them well together into a powder. Give two of the above pills morning, noon and night; give also a teaspoonful heaped up of the powder every day, an hour before breakfast and dinner, which is twice a day. The diet may be any thing that the patient likes best, and which will best agree with the stomach.

This prescription I was honored with by Dr. Edward Tiffin, late governor of the state of Ohio. I used it for my daughter, Nancy John, who had been four months in a state of alarming mania, or derangement; when she had taken it about two weeks, she suddenly came to her reason; and after using agrimoney tea a few weeks, became very stout and healthy.

The Doctor, in his letter to me, states, her diathesis "I take to be great debility, and (to use a common expression) the nervous system unstrung."

I think to apply in such a case No. 44 and 26, also No. 9, will likely prove a cure.

No. 46.

Syrup for the Dysentery.

I have for a long time, perhaps 30 years, prescribed in the following manner, and it has nearly always been used with success: Take a handful of garden rhubarb, or patience, or horse dock roots, or any one of these, and shred them up green or dry. Also, a handful of persimmon or wild cherry bark (either will do) put the root and the bark together into a quart mug or pitcher that will bear the fire, and put in with them four tablespoonfuls of sugar, and fill up the quart with boiling water; set it on the coals until it is drawn like tea. The patient is then to begin to take it, a tablespoonful at a time (if a grown person) every fifteen minutes, until ease begins to take place in the bowels; then not so often, and so by degrees break off; yet take some until good health takes place.

This syrup should be boiled every day, and a little spirits put into it to keep it from getting sour; and may be filled up and sweetened to the taste, or renewed as there is occasion.

Give at the same time a flour coffee (wheat or rye meal fried brown) boil it with milk and sugar in it, to fill up the belly and promote sweat by a plentiful drinking of it hot or cold: this will greatly assist the cure.

By this course the fæces, or lumps in the illium guts (which occasion the dysentery) will be gradually dissolved, and the cure be permanent; but the first effect or sympton of cure, is ease in the belly. See No. 25, 9, and 41. This syrup may be given in any diarrhœa or flux.

No. 47.

The Croup, or Bold Hives,

that so alarmingly choak children to death, being a swelling or stoppage of the lungs, I have cured by the following syrup for 12 years past: the success has been truly singular; it is a discovery of my own, by mere accident.

Take a handful of John's wort, No. 22, and a handful of sage, and sugar sufficient; make them into a syrup, in the manner directed in the foregoing number. The dose for a child six months old, should be only a teaspoonful; but to one six years old, a tablespoonful. The times and continuance may also be like No. 46. See No. 18.

No. 48.

Syrup for the Quinsy, catarrh, and ulcerated sore throat.

To prepare—Take one ounce of squaw root dried, or a like quantity of green, No. 17, half as much blueberry root, No. 16; boil the roots in three quarts of water to less than one, add alum and honey to make it rough and palatable. Gargle the throat, & swallow some pretty often.

Report is, that a noted root doctor of Jersey, near Elizabethtown, made use of this with the greatest success. I had it from Dr. Hole, who highly recommended it; but as these complaints scarce ever have prevailed where I have lived, I have never put it to the trial. A tea made of the root No. 16, will probably be a relief and cure in the most of such cases.

No. 49.

For the Canker.

The canker is a hot humor which has its seat in the stomach; shows itself in whitish sore spots on the tongue, palate, and inside of the mouth and lips, that will sometimes eat and consume away the palate. It is generally attended with fever and great thirst, uneasiness and distress. Children have been mostly the subjects of it, but sometimes it goes thro' the whole family; and to small children it has sometimes proved very mortal.

A Mr. Huston, from whom I obtained the receipt, cured it easily and certainly, if applied to in time. His prescription is as follows: lignum vitæ chips or dust, black snake root, No. 10, squaw root, No. 17, Virginia or Seneca snake root, black haw bark, John's wort, No. 22, beech drops, of each a tablespoonful powdered: of blue flag root, and blood or puccoon root, each a teaspoonful, if powdered; these put together are to be made into a syrup (say 3 half pints) in like manner as No. 46, and given like No. 47. The dose for a child is a teaspoonful every 10 minutes for the first hour; a tablespoonful for a grown person; then lengthen more and more between times of taking of it. If the belly is bound, clystering, castor oil, or some other gentle, easy purge ought to be given: sweet fern, blue whortleberry bushes and healall,* or some of them, are to be used as a tea. The syrup should be given warm, especially at first; and heated, filled up, or renewed, till its end is answered.

I have known cures by this medicine when the tongue had become black, and the blotches were spreading, eating sores. Milk diet is to be avoided, and all salt and dried meat; any other food may be freely taken. This disease is seldom found in southern climates. Try for it No. 14 in tea, and No. 48, but more particularly No. 16 in tea.

No. 50.

Pain in the Breast,

is often occasioned by an acid, or sour state of the stomach, or if you please, the stomach having too much rennet.

Make the following drink: chip green horse radish roots, as much as will lie in a half pint tumbler, and put them in a quart bottle; then take vinegar, and if strong, mix it half water, sweeten this with sugar pretty sweet, and fill up your bottle with it. Take this drink three times a day, about 10 minutes before meals; the dose a spoonful or two, or a wine glassful, as the stomach will bear it. This course will generally help the digestion; the want of which is frequently the occasion of the pain in the stomach. But sweet tea or coffee must sometimes be avoided, with every thing else that would turn to vinegar quickly. But when there is a burning at the stomach, which frequently happens by drinking drams, grog, punch, wine, &c. these are to be forborne or left off, as it may be presumed that they are the occasion. My No. 26 will often be a temporary cure, and ought to be tried, especially if there is flatulence or colic symptoms; yea, this pain is frequently only wind pent up, and the beginning of a colic.

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* The healall is a wild herb, bearing a whitish blossom, resembling red clover.

Pain in the stomach is a common attendant in a consumption, together with pain in the side and shoulder; then both the above may be moderately tried: but No. 44 will be most likely to effect the cure.

No. 51.

Persons stunned with thunder, drowned, strangled, or the breath suddenly lost or struck out of them by any accident, such as damp in a well &c. may often be restored by the following process:

Let a person of good strong lungs apply his mouth to the sufferer's, holding at the same time his nostrils close, and blow his breath (as we say) as hard as he can into the sufferer's lungs; he must then leave him to expire while he gets his own breath, and then repeat the effort as soon and as often as he can, perhaps a hundred times, if self respiration does not take place sooner. A reed or pipe like a weaver's quill may be made use of for the purpose, and sometimes a pair of hand bellows have been used; but I would prefer the breath, as most likely to keep the lungs and blood warm.

For drowned persons, cloths dipt in hot water ought to be laid on the breast as warm as a living person could bear, and a blanket dipt in like manner ought to be wrapt around the naked body, and the hands and arms, feet and legs should be rubbed with hot wet cloths; this warming and rubbing is prescribed in order to keep the blood from coagulating. Drowned persons, I think, should not be rolled upon a barrel, but only be laid with their heads down, so that the water in them may run out, and no violence done them; but the blowing should be begun and kept on as soon as possible.

In a treatise that I have read respecting the recovery of drowned persons, it is stated (if I mistake not) that they have been recovered who have been under the water five or six hours.

I once happened to be present at the town of Washington, Georgia, when a person was struck dead (as we say) with thunder; and I witnessed the before described process, as it relates to blowing the breath, and beheld the recovery of the person. This happened on a court day, about 30 years ago; many as well as myself saw the melancholy, but afterwards joyous scene. I assisted shortly after the shock, in opening a vein in the young woman's arm: but there was no spring or motion in the blood. The whole process that proved her recovery was ordered by Mr. Jer. Walker.

No. 52.

Stopping of Blood, and of Hemorrhages, are of great importance to be known. If you should be wounded, so as to wish to stop the blood: 1. Close the wound as well as you can, and put to it a large cloth wet with cold water, and drip on a little cold water for 15 minutes, keeping it as close as possible for twelve hours; sometimes it will be best to take a few stitches to close the orifice. But apply No. 37 in preference to every thing, if you can; and then the plaster, No. 30. Or 2. Take vinegar and disolve alum in it as much as is suitable, then scrape the soot from the bottom of a dinner pot, and moisten it with the alum and vinegar, so as to make a small poultice, and apply that; or if you can get it, take the powder of the leaves of lamb's quarter, and apply closely: this well known herb has been proven to be first rate for stopping blood. Or 3. Boil a strong decoction of the bark of the pignut hicory, this is the Indian styptic, and probably as good as any thing.

In hemorrhages, or discharges of blood from the womb or bowels—take a little vinegar prepared with alum as above, give a teaspoonful every 10 minutes, or as much and as often as the stomach will take. At the same time, if the case is urgent, apply cloths wet with vinegar prepared with alum as above, or in cold water, put them cold on the belly, and repeat them as occasion requires. But sometimes it is needful to take a little blood from the arm, as that will turn the circulation; then probably the above applications will take the desired effect. Alum dissolved in water, or alum whey, taken as much as the stomach can bear, until the hemorrhage ceases, are proper in extreme cases. But drink agrimoney tea, if you can get it, for two or three days, as stated in No. 9: and if the unhappy sufferer is much exhausted, to restore strength and good blood, try No. 44.

No. 53.

Bleeding at the Nose

is sometimes to be a little indulged, as they say it prevents the headache; but generally it is from debility, and shows a weak state of the system, therefore the sooner it can be prevented the better. In order to which, observe the following directions:

1. Blow your nose pretty smartly two or three times, and then bear against it where the blood issues, if you can, with your thumb, and hold it close a few minutes. 2. If this fails, dissolve

alum in good vinegar, as in No. 52, dip a little lint or fine rag in it, and put it into the nostril. 3. But sometimes a habit of bleeding at the nose frequently and every day takes place, and the blood becomes very vapid, so that it will hardly stain a cloth. When such a habit takes place, the only effectual remedy that I have ever found is to learn the person to smoke tobacco. This I have had to try for myself, or be exposed to bleed to death at the nose: but smoking a little every day has always overcome this habit, as far as my knowledge extends.

No. 54.

Bleeding at the Lungs

I believe, may always be considered as one of the expressions of great debility. What I shall say about it, take as follows:

1. Try about a teaspoonful of fine salt, which you may lick up by itself out of your hand; do this every day, or oftener, if the complaint is urgent. 2. The most likely thing that now strikes my mind, to be a radical cure, is to make use of agrimoney tea, the root as well as the tops; use it cold about three days at a time, and then miss three days, and so use it as a diet drink in some form. See No. 9.

You will wonder, perhaps, why I am always commending No. 9 for every thing: but as a reason I will state the following fact, which I personally know to be the truth:

An old man of my acquaintance, after a spell of the gravel, which nearly took his life, was for several months unable to retain his urine, but it dript from him continually. He was at length advised by Dr. George Foulk, a German, to drink agrimoney tea: this tea being the only medicine he used, he became a well man in a few days, being as free from this complaint as in his youth, and he was then above eighty years of age.

No. 55.

Linseed Oil,

for children supposed to be troubled with worms, has been generally my medicine. In raising my own family I have scarcely ever given any thing else. Let it be taken as follows:

Give a teaspoonful of linseed oil, put with as much sugar or molasses, morning, night and morning; that is, three times, then miss three, then give it again, and so repeat it until the child has taken it nine times. This is a dose for a child two or three years old, and respect should always be had to the age and strength of the patient. But see No. 44 for worms, and No. 21.

No. 56.

Preserving the teeth, and curing an odious taste in the mouth, may always, I presume, be effected by this little simple process:

Only wash and rinse your mouth every morning in your own urine.

Hezekiah Smith, D. D., deceased, late of Haverhill, Massachusetts, had his teeth all entire when he was above sixty years old. He told me the only means he had used, is what I have above advised, which he had followed from the days of his youth.

Relief from the ill taste I have proved, and I do not think the remedy worse than the disease. Those who know this in their youth, and will not try it, who can pity them when they groan with the tooth-ache!

No. 57.

The cure of venomous Bites and Stings, ought to be known, if possible, by every body; for a little delay will often render the bite or sting dreadful, and sometimes incurable. How important must it be to be able to cure the bite or sting of serpents and spiders, especially the black spider with a red spot on his back, called the tarantula, so common and dreadful in southern climates, hornets, wasps, bees, &c.

To cure any of these, you may only wet a thimbleful of indigo with good vinegar, to make it into mud, and apply it to the bite or sting. If done soon, the danger will immediately be over; and it is stated to me, that the place will not swell at all.

The above is a discovery lately made in Sussex county, New-Jersey, where the snake called the pilot, or copper-head, was so common and bit so many, that the mowers would scarcely venture into the meadows, until this discovery was made. They then kept some of the indigo mud by them, and found that they could cure themselves at once by this simple application.

But see Nos. 10, 11, & 17, and you may also remember that honey, sweet oil and hog's lard are severally good to take inwardly and outwardly, both for bites and stings. That man who received the sting of a bee on the tip of his nose,* and died in a few hours, might likely have been saved by any of these, had the application been made in due time.

No. 58.

The Thrush

is a sore mouth common to young children, beginning in little white scruffy blisters. Its cure may be attempted, 1. By the white elm bark (that is, the rough, not the slippery) make of the bark a strong tea, wash and gargle the mouth and let the child often swallow some, if it is only a teaspoonful at a time; this commonly brings off the scruff in a day or two, and does not terrify at all. Or 2. Make a syrup by dissolving loaf sugar in three or four tablespoonfuls of water, and add borax (the size of a grain of Indian corn) made fine; give the child a teaspoonful every 2 or 3 hours, until you find it is mending; then not so often, and by degrees omit it.

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* The case was related in a late newspaper.

No. 59.

Solution of Corrosive Sublimate,

for the yaws and venereal disease, may be prepared and applied, by taking, 1. Ten grains of corrosive sublimate, to a pint of good spirits. 2. one drachm of gum guiacum, to sweat. 3. One drachm rhubarb, to render it purgative.

Scorbutic and venereal diseases are cured by taking a spoonful of the above, morning and evening: drinking sarsaparilla tea plentifully, our bitter-sweet root, or little parilla, is quite as good, and I presume my No. 9 may be found a great deal better. The course about 10, 12 or 14 days, as the case may require.

Caution—This course ought always to be managed by a person of tolerable medical skill, for edge-tools may be dangerous in aukward hands.

Pain in the breast or bowels, or excessive lax, or salivation occasioned by the above, are remedied by taking brimstone; a large teaspoonful of the flour of sulphur mixed in honey or molasses, per dose. This is to be repeated daily until the complaint subsides, and the solution omitted.—But see No. 2.

With this course of the solution I once saved a man, nearly covered all over with ring-worms; other small applications having failed.

No. 60.

Solution for Tetters and Ring-worms.

To prepare—take five grains corrosive sublimate, put to two tablespoonfuls of spirits in a phial, and if found too biting, add more spirits. The tetter or ring-worm only need be touched with a feather dipt in this, two or three times daily. Warts, pared a little, may be touched in the same manner; continue to touch them till they are dead.

No. 61.

Tetters, or obstinate breaking-out a-kin to them, on the hands, feet or any where else, I think may be cured by the following preparation: take a half pint of brandy (peach I prefer) put it in a skillet with half a gill of tar, heat and stir them together, and stir in a large teaspoonful of potash; then bottle it for use. This need only be put on with a feather pretty plentifully for a few times, say every day for 4 or 5 days. My ideas are that some small inhabitants have their cities and plantations in these regions, but this anointing will overcome these Anakims as effectually as the people of the old world were overcome by the flood. You may try this for the itch, and for wens and cancers.

No. 62.

Old Dr. Witts' cure for Wens.

1. The patient must wash the wen morning and evening in his own urine, and once a-day he must grease it with grease broiled out of a wooden potlid, such as in old times they used on their

dinner pots; probably the marrow out of an old bakened hog's jaw would do as well. This is expected to break the wen in about two or three weeks, without pain; the contents being turned into pure pus or matter, will be discharged, and then the place may be cured up like any other sore, and will never rise again. 2. Should the above fail to break the wen, a hubbed toad may be just knocked in the head, and laid upon it; this, it is said, will surely break it. I think it ought to be two or three times repeated.

This account I received from Dr. Daniel Hunt, of North Carolina, above 30 years ago; he told me he had made several trials of it, and always succeeded; one he told me of, was as big as a two quart bottle, and hung down by a neck. I have made two small trials with success, which are all that I have had opportunity to attend to.

No. 63.

Cancers have been cured by the common Snails

They are to be dissolved in salt, on a pewter plate set on coals, and the slime or ointment applied by way of tent. In one instance, I was told, only the naked snail was laid to the cancer, and dried fast, and in a few days the cancer and its roots all came off together. This is a late discovery, but came to me well attested. Try muscles or clams out of the creek, if snails cannot be had. Cancers have also been cured by the following preparation: Take a handful of comfrey root scraped, fry it in half a pound of hog's lard, until it is crisp, then strain and wring out the grease; then add a tablespoonful of gunpowder pulverized, and a quarter of an ounce of red precipitate, rubbed together; then stir in and stew the whole to make an ointment. Put a fresh plaster of this on the cancer, morning and night, until the roots come out, or are killed: if it occasions much pain, there is too much precipitate in it. From Dr. Chn. Coffman.

No. 64.

The Tape Worm

has been expelled by taking alum, as follows:

Take pulverised alum, as much as will lie on the eighth of a dollar, mix it with a teaspoonful of molasses or honey, and let the patient take it in the morning, fasting; increase the dose a little every morning, and take it three mornings and miss three, until he has taken it nine mornings. This course, it is supposed, will destroy the whole breed of the tape worm in a person; and no one need be afraid of alum: at the same time let the patient drink a tea of the herbs No. 9, 12 or 21. Look at Buchanan's Family Physician for the symptoms.

No. 65.

Ointment for Burns.

To prepare—take six pounds of the leaves of squaw root, No. 17, or as much or as little as you please, beat them well in a mortar, then mix up these pounded leaves with fresh butter (say three pound) then wrap it up in rolls, about a handful in each, and lay them on a dish or board, and set it by in your cellar until it is covered and filled with mould (say two weeks) then mash it up again in fresh butter, and stew it gently an hour or two on coals, having grease enough to cover the herbs; then strain and wring out and put by your ointment for use.

If this ointment can be applied to a burn or scald, before it blisters, it will prevent its blistering at all; when a burn is raw, and exposed to smart, it will terrify a little when first applied; but if you melt your ointment and apply it gently and frequently with a feather, it will terrify less and less, until the smarting will be overcome by it, and you may expect the cure to be soon completed.

The green ointment, No. 29, may be applied in like manner, and will have the like effect. See also No. 7 and No. 14.

An account of this ointment for burns I obtained from Dr. Peter Evans, of Montgomery, Pennsylvania, about 35 years ago. He used always to keep it, and spoke in the most absolute terms in its commendation.

The following advice may be useful to some, respecting burns:

I have been told, that in glass houses is kept and used, a preparation of lime and linseed oil: unslacked or fresh lime is mixed in a vessel with water and stirred up, and when it settles, the water being poured off, they then pour off the pure whitewash, leaving the grounds or gritty part behind; this lime batter is then mixed with linseed oil, put in a bottle and kept in readiness. If they get burnt, who work at the glass, which often happens, they take a patch large enough to cover the affected place, and make a plaster by spreading it with this preparation, put it on, and go on with their business; *this plaster, in common, being an immediate cure.* If this is true, it may be of great use to be more generally known.

Note.—Whatever is a cure for a burn, will also be a cure for a frost bite, or sore occasioned by frost.

No. 66.

Pepper, for preventing the Fever and Ague.

If rightly taken, I suppose, pepper will commonly prevent all persons and families from taking the fever and ague, and perhaps most other bilious disorders.

At a season when you expect yourself exposed to the ague, keep fine black pepper by you; take about as much as will lie on the eighth of a dollar, and lick it up by itself if you please, or mix it in a teaspoonful of molasses or a little water, and swallow it. Do this every morning for about four mornings, before you go out, and then you may miss a week, and then take it again, and so go on, more or less, until the sickly season is over. The story connected with this process is as follows:

A certain man inadvertently rented a good farm, lying in the bend of a river, but was much alarmed when he heard that the ague always had heavily afflicted every family who had lived upon the place; but meeting with a certain physician, he received from him the before stated advice; this advice he and his family took, and found that they could escape the ague there, on that farm, as well as any where.

No. 67.

For the Asthma.

Take sena, pulverised; sulphur, and spermaceti, of each one ounce, two ounces cream of tartar, half an ounce anniseed, pulverised; rub them together in a mortar: take a teaspoonful in molasses, going to bed, two or three nights at a time, I have found enough for to relieve me. It is a moderate purge, and a little debilitating. See No. 44.

No. 68.

Ointment for the Itch.

To prepare—take sulphur or fine brimstone, salt, black pepper, pulverised; gunpowder or salt petre, and tar, of each a tablespoonful; put them in a mortar, and add fresh butter or fat, enough to make it into an ointment, and rub or mix it well together. Apply this about the joints, hands, wrists and hams, every night for a week; wear the same clothes for a week. This quantity will be enough for ten persons, never fails curing the itch, or does any hurt.

Precipitate Ointment.

To prepare—take three quarters of an ounce of red precipitate, three ounces of Venice turpentine, and half a pound of fresh butter; rub the precipitate in some of the turpentine and butter in a marble or brass mortar (not iron) or an earthen bowl, and then add the remainder of the turpentine and butter, and stir it again; then add nine spoonfuls of water, one at a time, stirring a little between every one, until all is well mixed.

This ointment is to be applied like the foregoing, only not so liberally, for the itch. It will also be good for any hot, itching humor. But care must always be taken not to expose yourself much in cold water, to wash in, or drink it, lest it bring a worse evil than it cures. If you get pains after using this ointment, by being exposed, take brimstone (say a teaspoonful) and drink sage tea till you sweat; do this for two or three nights.

No. 69.

A dislocated Shoulder

may be replaced by the following process:—1. Tie the body fast to a post with a sheet, or something, to keep it from giving way when the extension is made. 2. Let a strong person be provided to grasp the arm, and be directed to pull it in an even direction, from the body; he is to be instructed, at a signal to be given by the operator, that the arm must be moved forwards and a little down, so that the elbow will be moved about ten inches, a little briskly. 3. The operator must put his hands, one under the hollow of the arm, about where the knob or end of the bone is, and the other hand on the top of the shoulder, and when the extension is sufficiently made (which in common does not take very hard pulling) he is then to give the signal for the motion before directed, and at the same instant bear the knob end of the bone into its socket.

This commonly is not a hard operation, but it is important to know how rightly to go about it. If possible, when the shoulder is first dislocated, apply No. 37, and replace it as soon as you can; but if this has been neglected six hours, it is best to bathe the shoulder with hot vinegar, which may be repeated twice a day for three or four days; afterwards cold vinegar will be best, and lastly, if the shoulder remains weak, try No. 37 for a few days, beginning in the morning, and continuing the cloths for half an hour: but the whole of this vinegar, &c. may be omitted, if the first application, No. 37, be applied in time.

Follow it then with the plaster No. 30.

No. 70.

For a broken Bone.

When a bone is broken, let it be leg, arm or any other limb, the process may be much like that of the dislocated shoulder, and I think no material difference is necessary in the applications. The main thing is, at the time of the extension, try to get the broken-off ends of the bone together as well as you can, and have the bone straight in its natural position. Then if you have used No. 37 in time, you may immediately apply the plaster No. 30; then have ready a splinter work fixed between cloths and quilted, so as to wrap round and fasten with a lace or running string thro' holes, that you may loosen it and take it off when you please. When you have reason to believe that the bone is knit and getting strong, the stays may be taken quite away; but if the limb should seem to wither, or remain very weak, try the cold water cloth for a few days, as advised in the foregoing No. 69—for cold water is certainly, I think, the best thing to strengthen such withering limbs. After the wet cloth is taken off, the limb should be wrapt in dry flannel, but not kept very hot.

Every body should know that a light diet is the best for such unfortunate sufferers, or especially they should not eat much pork; otherwise they may eat and drink according to their own inclination, what is moderate and reasonable.

No. 71.

For a sprained Ankle or Wrist,

or indeed any other wrench or bruise, I advise 1. You had better try No. 37, than any thing else, at the beginning. 2. Then apply the sear cloth, No. 30, and little more need be done. 3. But treat it otherwise with hot vinegar, and generally like as directed No. 30, or 69, 70. The Porter's ointment, No. 29, may sometimes be of especial service.

No. 72.

General directions for venesection, or letting blood.

It is necessary to know—1. How to bleed—2. Where to bleed—3. When to bleed—4. When not to bleed.

1. How to bleed—The operator should have a good lancet, sharp as a razor; let him then put a bandage on the arm, above where he wishes to raise a vein, or on the leg or round the neck, so as to prevent a sufficient quantity of blood from reaching the heart, and to raise a vein; he should also be capable of opening the vein in a delicate and suitable manner, so as to make the vent or orifice about one-fourth of an inch in length.

I have been told that the Indians make a lancet of a nice piece of flint, which they tie in a stick & strike it, like a fleam, with another stick, and so open a vein very well: and it vexes a-body to think that any white man should make a more bungling and indifferent hand at letting blood than the poor Indian. But to be serious, due care and discretion ought to be used, not to injure the place on which you operate. If you have a spring-lancet, set it with judgment, just fairly to go into the vein, and no deeper, and by no means strike thro' the vein. When I lived in Georgia, in bleeding the blacks, I learned to rip the skin with my thumb-lancet (for I always have bled with sort) and then I could fairly and safely open the vein; and when I have bled a white person, I have chose to do it, by a slanting thrust, in the ripping way.

2. Where to bleed, I think of some importance —When you bleed for a bruise or pain, I think it best to chuse a vein as near the affected part as you can·get; and if for the pleurisy or pain in the side or shoulder, chuse your vein on the same side that the pain is, lest, as they say, you should draw the pain across the heart; and for a violent pain in the head, I would recommend to open a vein in the forehead. You may by drawing a handkerchief about the neck, raise good veins in the forehead; and if you open one of them, it will bleed as well as the arm, and I count it the safest place in the body; the skin is a little thicker than elsewhere, but the blood will never flow when the neck is loosed. I have experienced, from this operation, the most sensible relief in my own person, when from the pain in my head (as we used to say) my eyes were ready to burst. Let this be a general rule, when you bind up an arm to raise a vein, take that vein which rises best. From half a pint to three half pints, is a suitable portion of blood to take from a grown person at a time: and that ought to vary according to the strength and circumstances of the person.

3. When to bleed, I think a matter of singu-

lar importance—Generally, it will be safe to bleed in all cases of plethora and irritation; then expect the countenance fresh and the pulse high. If then the patient has pain and distress any where in the body, especially in the breast, you may let blood, and it will likely be to considerable advantage. Young men, they say, should be bled, if they are healthy, once or twice at about 20 or 21 years old; and women, if strong enough, about the turn of life, at the age of 40 or 45. Pregnant women, if strong and hardy enough, are recommended to be bled about the third, the fifth and the ninth months; and near to delivery, when their labor is like to be tedious.

4. When not to bleed, is a matter of still more importance for us to know than the former, if it be possible—I advise generally not to bleed in the cases of weakness, debility and languor; then the pulse will be low, the countenance pale, and bleeding will always then reduce the patient and make him more weak, and sometimes, I believe, will be the occasion of inevitable death.

No. 73.

For the Dew-worm, or child's sore head.

Take one spoonful of tar, one spoonful of the scraping of a copper kettle, black pepper and brimstone, of each a teaspoonful, and tallow the size of a hen's egg; put all in one pint of spirits, and simmer them together over a fire to an ointment. Anoint the child's head once a-day until it is well, and let him wear the same cap.

No. 74.

Ointment for the Piles.

To prepare—Take elder roots, hearts of plantain, of burdock, of mullein, mallows, catnip and motherwort, a handful of each; to be stewed in one pound of fresh butter—with this the patient is frequently to grease himself. See No. 14.

Note—No. 73 and No. 74 are old Dutch receipts, that have often been proved.

No. 75.

For a person breaking out with Boils.

Take elder stalks one year old, cut them in chunks, split them open, and fill a pint mug or vessel with them, and put on cold water to stand all night; let the person drink half a pint of the water in the morning. Renew and drink three mornings successively. This little course will so purge and cool the blood, as to prevent their rising any more.

Boils are generally thought to be a sign of health, but they are so sore, that you will wish to prevent them, if you can. When a boil first appears, it commonly has a little white head with a small drop of matter in it; if then you will pierce it, a little lower than the skin, and squeeze out a drop of black blood from the bottom, it will die away and hurt you more. But sometimes boils rise in great abundance, and I have heard of some instances of their taking life. Prevent them then, in time, if you can.

No. 76.

The cure of bilious, typhous or nervous fevers may be attempted in the following manner:

1. Give No. 1, to move the bile; this is preferable to any thing else, I believe, to lay the foundation of a cure, as it will brace the stomach (the common ipecacuanha may answer) and fit it to receive the following.

2. As soon as the puking has ceased a little, give No. 25, and continue this according to the prescription, until the patient is quite well.

3. Keep No. 26 in readiness, and if any thing of the flatulent or colic kind is perceived, give it freely according to the prescription, until that is overcome; No. 25 and No. 26 may both be used together, and I believe they will always be found sufficient to carry off the remaining bile, and they will give ease and sleep; but the patient should take, as soon as he can, the coffee directed in No. 46, and proceed to other nourishment as the stomach will take it: this commonly finishes the cure.

3. When an obstinate hickup has taken place, I have dissolved three or four pills, No. 26, in a spoonful of hot water, and given it; and continued to repeat it while there was occasion. Perhaps No. 16 in tea would do as well, or better.

4. At the beginning, if there is extreme pain in the head, take a little blood from the forehead, as mentioned in No. 72, but the quantity ought to be according to the strength of the patient; and blood in like manner may be taken from the arm, in case of extreme pain or distress in the breast.

5. If coldness of the extremities remain after the operation of the emetic, give No. 24. I have found the needed, tho' despaired of, assistance from this. I have by this course recovered persons who had been vomiting several days (as long as ten) and have found them recover, when even dying symptoms were upon them. I have tried to excuse persons who have been long and hard vomiting, from taking No. 1, but have found it impracticable. These hard cases I have suceeded in, when their physicians have abandoned them. See preface.

6. Every body should know, that a passage should be procured, in a fever, thro' the draught; but after the puke, if need be, it will be best to procure a passage by injections.

7. If the fever does not yield to the above applications in two or three days, give the sweat No. 39; and always try to keep up the perspiration by a plentiful drinking of some suitable herb or root tea, such as No. 9, 10 or 12, or sage tea.

It matters little what you call the disease—remittent, camp, bilious, nervous, typhus, yellow fever or sick stomach;* all will yield to the above directed process, or I am mistaken—the commission of death only excepted.

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* The yellow fever and the sick stomach I take to be the same disease; their difference being chiefly in external circumstances. But they are both, properly speaking, the bilious fever.

No. 77.

For a swelling of the belly and legs after a fever, or by taking a cold.

Take a pint of mustard seed, ground or pounded, and a double handful of horse radish roots, scraped or shreded; steep them in half a gallon of stale cider, in a jug, and shake it often. After 24 hours begin with half a gill per dose, or what the stomach can bear; take it in the morning, and always before meals thro' the day, till you are relieved; and continue to take some at times.

If hot pimples or boils break out on the skin, wash them with a decoction of maple bark.

This has been found a very successful remedy in the southern states.

If cider cannot be had, this medicine may be prepared with vinegar, reduced, sweetened, &c. like No. 50.

No. 78.

The Hydrops, a cure for the Hydrophobia, or bite of a mad dog.

A certain herb is now known, and cultivated in gardens, that from the best information is an effectual remedy for this most alarming and awful disorder.

This herb I call hydrops, but by some of the Germans it is called huner dorm (or alsine, latin) and from among them it came into use. But from a Dutch herbal, the herb by that name appears to be another thing—that has a yellow blossom, this a beautiful pink red; that lives thro' the winter, this dies with the frost, and comes up from the seed in the spring.

The hydrops is a small running vine, a little resembling the madder; its stalk or vine is four square, having two leaves at a joint, one on each side, and the next leaves are transverse; a grown leaf is about three-quarters of an inch in length, a beautiful oval, without notches or roughness any where; the under side of the leaf is thickly speckled with brown or dun-colored spots, not much larger than the prick of a pin; on the set of the leaf, joining the stalk, are sprouts, some becoming roots, some new vines, and some the beautiful lilly, which begins to show its red leaf when near the size of a grain of wheat, supported by a little round stem about an inch and a half from the stalk; the bud or heart abounds with these little transverse leaves, closely crouded.

These vines put out thick in every direction, creeping on the ground and taking root at the distance of a foot or two from the first root; and when it has once gone to seed, it will come again the next year without sowing.

The tradition or saying is, that this herb ought to be gathered on the longest day in the year, in the forenoon; but I believe this is only a foible, for it must be like other herbs, best when in its bloom and greatest perfection. The Dutch herbal directs to gather the huner dorm when the sign is in the twins, or breast; and they may do that who please, I dare say it will do.

However, the old lady, mother Cints, in whose garden I found the herb, and who gave me the most correct account, which she states from certain facts with which she was acquainted, says *it will do to take it green out of the garden, at any time, and make a tea of it*, and it will cure the bite of the mad dog.

The manner in which the hydrops was directed to be given by father Miller, is to have it dried and powdered, and to put as much of the powder as will lie on a quarter of a dollar, on a piece of bread and butter, and let the person or creature eat it; and let this be done three days successively. (But we may know that a cow or a horse may take ten times as much as a man.) It is advisable to lose no time in giving it.

In this manner a family with whom I am acquainted, made a fair and successful proof of it. A boy and a dog or two took the powdered herb, and continued well; while some other creatures, bitten at the same time, underwent the awful agony and died.

The efficacy of this herb, in curing the bite of the mad dog, is asserted by so many, that no doubt of it can remain. It has been published in the public news, and in a Dutch almanac, but I have not had the advantage of either of them to assist me in this prescription. This is the cure mentioned in the preface.

My acquaintance with the hydrops is too small to enable me to judge much of its virtues, or of its general operation. But I make no doubt that it possesses the most rare qualities. Probably it may be found an antispasmodic of the most salutary kind. I think it may safely be tried in mania or derangement, epilepsy, cramp, hysterics, &c. and the quantities, times and manner of giving, may vary at discretion.

No. 79.

For a diarrhœa, or looseness of the belly.

The following has been found peculiarly efficacious, when other means have generally failed:

Take the yard or pizzle of a buck (get it saved and dried by a deer hunter) reduce it to powder, put a spoonful of the powder in a bottle with a pint of spirits; take this solution in small quantities, every hour, till relief is obtained; say from a teaspoonful to two tablespoonfuls, as the case may require.

This I remember to have heard, was used in camp, in the old Canada war with the French, when the complaint was very common, and had carried off many; but when this was applied, it was found a speedy and certain cure.

I have known this kept as a family medicine, and given with success to both man and beast.

No. 80.

For a stranguary, or depression of urine.

When a person would make water, but cannot, but with pain and difficulty, from whatever occasion, the following may be tried:

Make a tea of the slippery elm, buds or bark, or lyn buds or bark, either may be used; the tea must be plentifully drank and continued till the patient is well, less or more. Small doses of nitre and camphor, are the usual remedies; but the above tea is perhaps preferable, and the others may be resorted to if it fails.

No. 81.

For the diabetes, or an excess of urine.

I have found a coffee made of flaxseed, and used as a constant drink, of singular benefit.

No. 82.

For a person struck with the Dead Palsy

the following advice may be highly important:

Get good spirits of any kind, such as Jamaica spirits, brandy, gin or whisky, it is not material which, but the first has been oftenest tried; wet with the spirits the hand, arm, foot and leg, and the whole affected side, three times a-day, and rub the most numb and affected part with a woolen cloth; continue the application for two or three weeks, or until a recovery takes place.

This application has been several times tried, that I know of. I hearn of it in New-Jersey, in several instances, more than twenty years ago; but never had an opportunity, till since the present copy of this work was written, to see the proof of it under my own notice, and this was with success.

No. 83.

To expel Worms by external application.

Take beef gall and rue juice, equal quantities if green, and a like proportion of the gall and a decoction of the dried rue; stew them together till you can spread a plaster with it. Then apply a plaster about three inches square on the pit of the stomach, and expect in the space of forty-eight hours the worms to be expelled; some gentle purge should be given, about the second day, to carry them off.

This application has succeeded, when many others have been tried without the wished for relief.

No. 84.

The cure of Fevers by external application

may be attempted by preparing the slippery elm bark, to make a poultice (that is by stripping, scraping or pounding it in a mortar, and then working it to a slimy mass with a little water) this may be put into a small bag prepared for the purpose, and laid a little warm to the belly of the person in a fever. This poultice should be removed, and a new one applied pretty often, for it will soon become infected and loathsome. This application has succeeded in obstinate fevers, when internal medicine was apparently useless.

No. 85.

The virtue and right use of the Yellow Springs, or chalybeate waters,

I am persuaded would be of special service to be known. The following are my ideas:

Those waters that are well impregnated with *iron-mine*, possess medical properties of the most healthful and restorative kind; which for safety and efficacy exceed all other medicine.

They answer, 1. To recruit the oxygen in the blood (see No. 44 in the note) *No. 44 may be joined with the use of this water, perhaps to a considerable advantage.*

2. To strengthen the stomach, and the system in general; and to give a good appetite for, and digestion of food. It will sometimes raise a person, when any other means would be worse than none.

3. Female weaknesses and rheumatic complaints may be frequently relieved by a moderate, but plentiful drinking, and prudent bathing.

4. Consumptive persons may be cured by these waters, when other means would fail.*

5. Those families who live by, and drink this kind of water, are peculiarly healthy (to an individual) in every part of America.

But observe for the diseased, 1. There should be a copious drinking of the water for a considerable time, perhaps for three or four months together; and drinking will frequently answer all purposes, without bathing.

2. Bathing should be quickly performed, and the body should be covered and got warm as

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* There are sulphur springs in America; they have a yellow spew, but smell and taste like gunpowder, the drinking of which is noted for hurrying off consumptive people. The warm springs in Bath county, Virginia, and those on French Broad river, North Carolina, have the same character.

soon as possible; once in 24 hours is enough—oftener will do more hurt than good, especially if they take cold, and that a person bathing is sure to do, if not soon got warm.

3. No person should take the cold bath when heated by walking or work; the morning is generally the best time.

4. It may be noticed as an invariable maxim, that whoever takes the cold bath (sick or well) and can get quickly warm, will be benefitted by it.

These waters, if good, are covered with a blue scum, where they stand, and do not run off immediately; and are frequently very cold—they cover wood and stones (that they run over) with a deep yellow paint, like what is commonly called copperas color.

The Yellow Spring, in Green county, Ohio, has emitted a spew like the above, that has formed a vast heap of paint, like iron rust or Spanish brown: and the water is conceived to be of the first rate medical quality. Also, there are many other springs in the state of Ohio of the like virtue, and doubtless in many other places in America.

Commonly when a person takes a good potion of this water, in a little time (perhaps in half an hour) his urine will become as clear as the water he drank, and he finds himself cool and lively in his feelings.

Persons should drink this water, not because they are thirsty, but because they will drink it.

Tho' the taste of this water is disgusting to some at first, a little use brings it to be altogether agreeable. The quantity to be drank at a time, may vary from half a pint to a quart, as the stomach can receive it; but some drink two quarts. It should be drank some time before meals (say half an hour;) mostly after a light draught, the stomach throws or gulps up a little wind; the person then may drink copiously afterwards, and all will lie easy: but if the wind is not thrown up, it causes to vomit. But a few trials, and a little use, will make it perfectly agreeable to every one.

The water is never counted good, when kept long from the fountain.

THE END.

[The following Numbers, additions and alterations have been collected and written since the book was put to press, and a considerable part of them bound.]

NO. 86.

Vaccine Innoculation

Is now fully established to be an antidote against the small-pox.

This was discovered and introduced about the beginning of the present century, (i. e. the 19th) by some Doctors in England, who transmitted it to America.

It has now been practised with, for about 12 years, to general satisfaction, and patronised by two of the honorable presidents of the United States of America, Jefferson and Madison.

The history, as near as I recollect, is as follows: Certain Milk-Maids, in England, being inoculated with the small-pox, it was found that the small-pox could not be communicated to them; and when the reason was sought, it was conceived that the said Milk-Maids had taken an infection from the Cow's bags or teats, on their hands, which had brought blisters and sores on them; and that in the instances where this had taken place, the small-pox could not be communicated.

* The Cows are said to have had such watery blisters, terminating in a scab, on their bags and teats; and it was from these blisters, found upon the cows in England, that the vaccine inoculation was begun; and for this reason it was called the Cow-pox or Kine-pox.

Now the process I would advise:

1. Take the watery slime, at about the 6th or 8th day, from the arm of a healthy person who has been innoculated, while the blister is still in its clear state; for when it becomes yellow, it will be uncertain to give the infection.

2. Raise the cutis, or grain of the skin, about two inches above the knuckle bone of the wrist, with a lan-

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* Whether Cows in America have ever such watery blisters and scabs, I am not able to assert:—But I have heard that a cow was inoculated with the small-pox, and she had the disease fairly. Matter was taken from her and tried (at least on one person) but it was found to be the small-pox still, in all its inveteracy. This was done in the state of Ohio.

cet or needle, into a little cup, so deep that the water will just rise in it; then introduce a small drop of the above, such as you can carry on the point of your lancet or needle, into the raised cup—and cover the inoculated cup, with a little lint or clean cotton, touched with spittle, or the white of an egg, to make it stick.

3. In a few hours the lint may be removed from the arm; and if the infection has taken, it will show a little inflammation in 48 hours. All excesses in eating, drinking and exercise should be avoided, as the system will be thoroly affected; and frequently the person will experience, chills and a slight fever—and kernels in their groins and under their arms—and you may expect the sore on the arm to be considerable.

The reason why I would prefer the wrist to the upper part of the arm, is because I think it a more favorable place to keep cool, and wash frequently with a rag diped in cold water, which should be carefully attended to, during the first stages of the rising of the blister, and inflammation; and if you must have a sore arm it is better to have it there.

If you have to carry the infection any distance or time, I would advise to carry it on a cotton thread, absorbed full of the vaccine water, dried moderately before the fire, and dropped into a phial—This may be cut to pieces, and moistened with spittle on a bit of glass or earthen, and the bigness of half a pin's head will do to inoculate a person.

If you wish to preserve the infection for a considerable time, you may save the first scab, taken off as soon as the watery state subsides. Seal it in a phial, and it will answer for years, to begin this inoculation.

We have to say, in favor of this vaccine inoculation, that no one ever catches the infection otherwise than by being inoculated; and we have heard of no one's death being occasioned by it, young or old: but the small-pox inoculation carries off many.

If this inoculation should be still attended to, the rising generation will scarce ever see the truly deplorable and affecting scene of persons dying, or torn to pieces with the small-pox, which every human creature is exposed to, if not secured from it by vaccine inoculation.

NO. 87.

Tincture of Cantharides.

To prepare—Take half an ounce of cantharides, (or Spanish flies) pulverise them and put them in a bottle with half a pint of spirits, shake them together a sufficient time, then strain out what you want for present use, thro' a fine rag, two or three double.

The particular use of this medicine is to remove, in females, that obstruction usually occasioned by catching cold, frequently so fatal to women, (i. e. obstructed menses.)

I would advise to have this in readiness; and after trying No. 27 or No. 44, to recruit the system if possible and prepare good blood, for 5 or 6 days, then give this tincture.

Begin by dropping three drops in a little water (say a wine glass full) let her drink it, and repeat the doses three times a day, adding one drop more in every potion, until a stranguary takes place, or the wished for fluor; then stop, and attend to the remedy for the stranguary, No. 80.

Then rest from this 4 or 5 days, and in this time give one of the chalybeates above mentioned; then give the tincture again, beginning with the number of drops which you last gave, three times a day, till one or the other of the before-mentioned succeeds; then stop and proceed as above directed. If the end is not answered by the second effort, try the third; but I think, commonly speaking, you need not rise above 15 or 20 drops at a dose.

This course commonly speaking, gives no disturbance, and will be found a safe and easy process, and very sure to succeed, if such a thing be possible—it being one of the gentle attempts to be made in the stimulant course, and will frequently be the cure of fits, approaching consumption, &c.

The fluor, once obtained, will commonly regulate itself: at least with the assistance of No. 8.—But in the cases, so critical and delicate, I advise, that the patient be under the notice of a skilful physician, if such can be had.

NO. 88.

To prevent or counteract a mortification.

Prepare the following: Take brimstone and allum, equal quantities (say the size of a thimble) put them both in a scale and balance them with gun-powder; then pulverise them separately, and mix them well together. Take of this mixture, as much as can lie on a quarter of a dollar, make it into a potion, with vinegar and water (say half a gill) for a grown person; and in proportion, for a child. Let the patient drink it without delay. Its first effect, commonly, is a chilly fit or shivering, which is to be esteemed a good symptom of its success. The like potion may be repeated daily, till taken three times which is commonly enough. It usually will bring the patient into a good state of perspiration; but its peculiar intention is to move and loosen all obstructions thro' the system. The good effect will commonly soon appear in the tumor or wound, or affected part of the body, where the mortification is feared, or may be begun; and will greatly assist external applications to save life, if it be possible. For external application, apply No. 7 or No. 14, if convenient; but a decoction of dogwood and sassefras roots, to wash and poltice with, is very good.

I have applied this mixture for an obstinate cold, as we call it, when the lungs could not be relieved by raising or coughing up any thing, and I found it to have a speedy and happy effect.

I was favored with this medicine by Dr. Geo. Foulk, a German.

NO. 89.

For persons lean and poor in flesh,

I would advise the following: Take a teaspoonfull of sugar, and just whiskey or spirits enough to dissolve it and make it swim, (say a tablespoonfull) infuse them together, and let the poor person drink it of a morning and eat something in about 10 minutes; but drink no more spirits thro' the 24 hours.

Try this every morning, for two or three weeks. This I conceive will increase the quantity of chyle in the stomach, and recruit the blood, and nourish all the exterior of the body in a special manner.

These ideas I have formed from what took place by two of my acquaintance making use of the sugar and whiskey as above; and from being very spare and poor in flesh, as was their common habit, they became very healthy, stout, robust, and fleshy enough; and I think they may be a good example for others.

NO. 90.

The Silver Root

Is famous, as a poltice, to relieve rheumatic pains, when seated in a knee, shoulder, &c.

This root may be known by its small stem, about two feet high, strung towards the top with blue blossoms. It grows in marshy places, and on sandy banks of creeks, where the freshes have washed. The roots, when digged or pulled up, are white as silver, from whence it has its name—are small, and grow from their stool in every direction. They taste aromatic, but not severe. They should be pounded and applied. I have tried this but a few times. They succeed beyond expectation; and its character is that of an absolute cure.

[*The following is intended, in any future edition, to be inserted instead of the No.* 18, *in page* 40 *of this book.*]

NO. 18.

The Back-ache root

Grows frequently in dry prairies and glady barrens, in the western country and state of Ohio; and I believe it may be cultivated from the seed.

It is called *back-ache root,* from its special use for that complaint (the back-ache.)

It is also frequently called *colic-root,* because it is a known cure for the colic. But its more ancient name has been *The Devils Bitt.*

The top is a round weed, from two to five feet high, having no branches at all, but thickly strung with long scattered leaves. About one fourth of the stalk from the top point, is covered, in the summer, with purple blossoms growing out of the stalk like the mullen; but the stalk is not much bigger than a pipe stem, and seems as if it grew always in a bunch of grass, which grass indeed is the leaves of the root.

The root itself is a lump or knub of irregular form, and various in shape and size; its taste is mild, resembling the taste of allocompain, or a pine bud, or both.

The properties of this root I conceive are special, being a mild aromatic, yet a powerful stimulus; answering generally as an antispasmodic, and may be found useful in all the nervous disorders.

In using the Back-ache root, observe,

1. A chew of this root is a quick relief for the tooth-ache.
2. By chewing this root, persons have been cured of the colic and finally of the habit, or return of it.
3. *The Croup or bold Hives,* have been speedily cured by drinking a decoction of this root, making the same root into a poltice, and laying it warm to the pit of the stomach. The decoction should be given, as liberally as possible, till the child gets relief.
4. I have found the decoction of this root, a speedy remedy for the head-ache.
5. The back-ache has been cured by this root, and in

one instance, it was taken in bitters, chewed, and in decoction, so that a man took as much as six pounds of the root in nine days, but had his back cured, with which he had been a cripple for some years.

6. I have experienced myself, great relief in a chronic rheumatism, by only taking it in liquor as bitters.

7. From the foregoing facts, I am encouraged to think, that a decoction of this root will likely cause the intermission of a fever, and may perhaps become a general cure for fevers; but a purge, or vomit, should be given before it.

8. It merits a trial in hysteric, and hypochondriac complaints, and in all cramps, spasms, epileptic and convulsion fits, and to prevent the return of the appoplexy, that king of terrors.

Observe—That the using of this root has never been known to issue in indirect debility. It never occasions vomiting or purging, nor a flow of urine, sweat, or saliva; nor does it occasion sleep or stupor, like opium; but the patient sits easy as to all these, tho using this pungent root most liberally.

If these ideas should be justified, when put to a sufficient further proof, this root must be placed in the first rank of simples, of all the materia medica; and I should not hesitate to conclude the entire propriety of these remarks, was it not that I remember to have heard, fifty years ago, that it was a root of excellent virtues; and we may wonder why those virtues have not brought it into use, more generally ere now. But, why should we wonder when so small a portion of the riches of the field of nature is yet discovered?

ADDITIONS AND ALTERATIONS.

Page xxi, instead of the second paragraph of chapter iii, read—It would surprise you to see this floating all over you, in a state of good health, like water over a piece of watered meadow, and a steam flying from you in every direction, like your breath in a frosty morning, which you might discover by a good microscope.

To be added to the introduction, page xxii.

Before I quit my introduction, I wish to lay down two general rules in taking medicine.

1. If the patient has ever received special relief from any one medicine, try that again in almost any complaint, for that person.

2. Never trust to one medicine alone, where the complaint is severe or obstinate; but give the first aid by the next best that you can get.—Two men with handspikes, may roll a log that one cannot.

Page 69, line 13, add—New-born infants, strangled in the birth, may frequently be restored to life by the like process.

Page 77, at the end of No. 61—Note, if it be true that cancers and wens are occasioned by the residence of a family of worms, we may be pretty sure of the success of this preparation, if duly applied. A tincture made of No. 19, and applied as above, would likely succeed. If there be a running sore, dress it with the bark of the common Red-root made into a powder, and cover as far as you have annointed round, with some kind of plaster to keep out the air, and dress twice a day.

Page 90, at the end of article 8, 21st line from the top, add the following: Give No. 2 every other day as long as the fever continues. If the distress is great, give it in the fever. I have found the distress abate immediately.

ERRATA.

Page vi, 1st and 18th lines, for "*Leotrill,*" read *Lectrill.*

Page xxii, 4th line, for "lap" read *lax.*

Page 44, last line, for "third," read *thirst.*

do. 89, 4th line, from the bottom, for "hurt you more," read, *hurt you* no *more.*

Page 46, 3d line No. 27, for "two anvil scales." read *two* ounces *anvil scales.*

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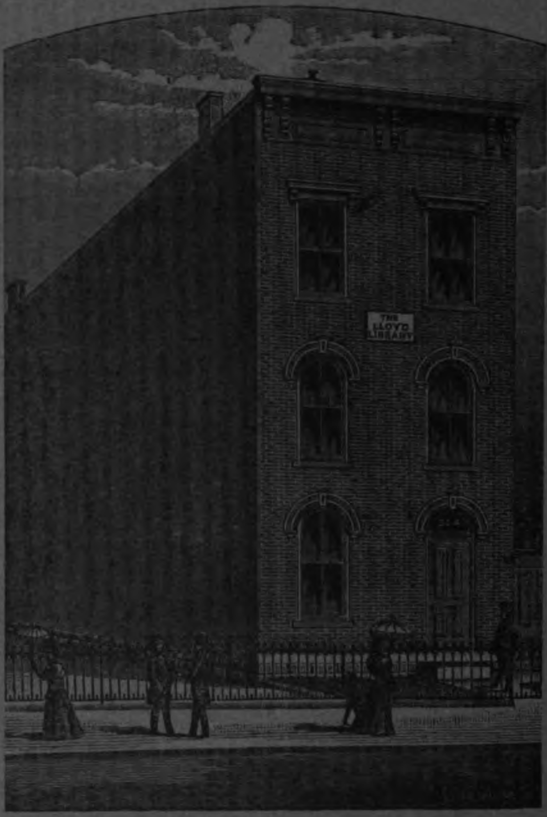
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BULLETIN
of the
LLOYD LIBRARY
of
BOTANY, PHARMACY AND MATERIA MEDICA

J. U. & C. G. LLOYD
CINCINNATI, OHIO

PHARMACY SERIES, No. 1

REFERENCES TO CAPILLARITY
TO THE END OF THE YEAR 1900

Being CHAPTER VII of
"A STUDY IN PHARMACY"
By John Uri Lloyd, Ph.M.

The References collected and abstracted under the guidance of John Uri Lloyd
by Sigmund Waldbott, Ph.D.
[illegible]

BULLETIN OF THE LLOYD LIBRARY

For some time we have been considering the advisability of utilizing a number of the rare works on the shelves of the Lloyd Library of Pharmacy and Botany in a manner that will conserve the interests of scientific societies and libraries. Our plan is to publish in as nearly facsimile as possible, the rarest of the early works connected with Pharmacy, Materia Medica, and Botany, and to supply them by exchange to journals and societies connected with these branches of science, and also at the nominal price of $1.00 per issue to persons who desire them for their private libraries. But while this will be a feature of each Bulletin, we shall also aim to contribute more or less original matter, such as biographies and portraits, as well as other subjects of interest.

The contemplated new departure for the Lloyd Library is now accomplished by instituting the series of Bulletins, of which this is the fourth number.

The preceding Bulletins issued by the Lloyd Library were:

No. 1, Collections for an Essay towards a Materia Medica of the United States, by B. S. Barton, (Reproduction Series, No. 1).

No. 2, The Indian Doctor's Dispensatory, by Peter Smith, (Reproduction Series, No. 2).

No. 3, The Genera of Gastromycetes, by C. G. Lloyd, (Mycological Series, No. 1).

The subject of the next Bulletin (Bulletin No. 5) will be The Geasters, by C. G. Lloyd.

One of the Bulletins to follow will embody a reproduction of the Materia Medica Americana of Schoepf, which was the first botanical work connected with American medicinal plants.

THE LLOYD LIBRARY,
CINCINNATI, OHIO, U. S. A.

BULLETIN No. 4. 1902. PHARMACY SERIES, No. 1

BULLETIN
of the
LLOYD LIBRARY
of
BOTANY, PHARMACY AND MATERIA MEDICA

J. U. & C. G. LLOYD
CINCINNATI, OHIO

PHARMACY SERIES, No. 1

REFERENCES TO CAPILLARITY
TO THE END OF THE YEAR 1900

Being CHAPTER VII of
"A STUDY IN PHARMACY"

By John Uri Lloyd, Phr. M.

The References collected and abstracted under the auspices of John Uri Lloyd

By Sigmund Waldbott, Ph. D.
Librarian of the Lloyd Library

INTRODUCTION TO

"REFERENCES TO CAPILLARITY"

About 1880, the undersigned became interested in capillary phenomena, especially the phenomenon of the pendent drop that becomes manifest when mixtures of a heavy liquid, as for example, chloroform, and a lighter, immiscible liquid of greater capillarity, for example, water, are shaken together in a vial and allowed to separate. This *pendent drop*,* seemingly heretofore unobserved, invariably forms under these conditions and, a constant factor, always droops from the centre of the surface of the lighter liquid. Its study led to an interesting line of experimental investigations, which yet under consideration, involve the surface contact of immiscible liquids, and the meniscus that forms between them.

About 1890 considerable journalistic discussion arose concerning the field of the pharmacist's labors and the pharmacist's opportunities in recreative thought and experimental investigation. With a view to illustrating the fact that most entrancing opportunities are ever open in our own province, the afore-named striking phenomenon, apparently insignificant, that for years had led the author to much pleasurable research, was taken as a text.

But before venturing to introduce the subject of his investigations publicly, it became necessary to determine that the field had not been preoccupied. With this intent, a résumé of the literature on capillarity was attempted, and in 1894, under the title "A Study in Pharmacy," the first fascicle preliminary to its consideration was distributed to a select list of recipients presumed to be concerned in such studies.

It would not have been possible for the undersigned to have even thought of making this record of the special references to capillarity had it not been for the co-operation of Dr. Sigmund Waldbott, Librarian of the Lloyd Library, who, appreciating the necessity for thoroughness, with vigor and persistence, set about the work of correlating the literature on that subject. As the work progressed, it became evident that the field was much greater even than could possibly have been anticipated, many connecting lines, such as electrical phenomena and other phases of physics and chemistry, becoming involved. Extended time was thus found to be a necessity for searching and making a comprehensive consideration of the literature consulted, which in the aggregate proved to be enormous.

From 1894 to 1902, as fast as it was possible to complete them, fascicles of this research have been successively issued, the portion concerning capillary references bringing the work to the close of the nineteenth century. The result of it all is a failure to discover that any person has intruded on the special field the undersigned invaded in his experiments with the pendent drop and contact lines between liquids, which, however, owing to delays incident to this literary research, have been held in abeyance and are yet to be recorded.

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*A term coined by the writer as being expressive and appropriate.

It has been suggested, now that the references are completed, that the pages relative to capillarity be placed at the command of persons concerned in science, and it is with this object in view that this special section of "A Study in Pharmacy," is herein reproduced as Bulletin No. 4 of the Lloyd Library Series.

In closing, the undersigned wishes also to acknowledge his indebtedness to the Librarian of the Public Library of Cincinnati, Dr. N. D. C. Hodges, and his predecessor, the late Mr. A. W. Whelpley, for their many courtesies and attentions during the course of the research.

JOHN URI LLOYD.

CINCINNATI, MAY, 1902.

CHAPTER VII.

OUTLINE OF STUDY.

The word capillarity (from capillus, a hair,) originally applied to the phenomenon observed in a portion of liquid that rises above the common level, as water in a narrow glass tube, now embraces several sub-sections. Since brief reference only is made to this phenomenon in our pharmacal works, and as in none of them do we find citations that assist us in the study of this neglected section of pharmacy, before entering into a more detailed review of the subject embraced under the blanket term capillarity, it seems proper to present references to such connected literature as has been consulted in the production of this résumé. With this object, an endeavor will be made to begin with the earliest reference and end with the current year.

It should be borne in mind that the list is offered as a guide to the closer study of any one of the many ramifications of this vast subject. Although in some respects the list may be wanting here and there in completeness; yet it seems improbable that many conspicuous workers in capillarity have been overlooked. While it is impractical to present a complete detail synopsis of each paper, an attempt has usually been made with each citation when the title is not expressive to give a brief idea of the subjects embraced therein. The heavier type gives the full title of the work, the nonpareil type following gives a synopsis of its contents. Moreover, an attempt will be made at the end of the list, to embrace in a concise summarizing outline, the main data furnished by these references. The list is recorded in chronological order, instead of being classified by subjects, or alphabetically by authors, and in subsequent groupings references will usually be made to it by these list numbers.

LITERATURE ON CAPILLARITY.

1. 1452-1519. LEONARDO DA VINCI. See *Pogg. Ann.* Vol. 101. p. 551. [1857.]

Poggendorf gives the following historical points on capillarity:

Libri, *Hist. des sciences math. en Italie.* T. III, p. 54, states that descriptions of experiments relating to capillary phenomena are recorded in the Manuscripts of Leonardo da Vinci, which are deposited in Paris; thus this celebrated and versatile painter must be regarded as having first described capillary phenomena.

Nelli, *Saggio di storia letteraria florentina*, p. 92, and

Lalande, *Dissertation*, 1770, (see No. 29,) ascribe the discovery of capillary phenomena to Nicola Aggiunti, who died in 1635.

2. 1660 (thereabouts.) FABRI, HONORATO. See Buelffinger. No. 19. (*Colleg. Curios.* P. I. Tent. VIII, p. 44, 45.)

Records some observations pertaining to capillarity, e. g., that water rises higher in narrower than in wider tubes, and higher in moistened than in dry ones, and ascribes the cause of the ascent to the pressure of air, which can exert itself; more freely on the surface of the outside water, as it is more abundant there than at the water surface within the tube.

3. 1667. MONTANARI, GEMINIANO. *Pensieri fisico matematici.* Bologna 1667.

C. Brunner, Pogg. Ann., 70, 489, (1847) attributes to him the merit of having given the theory of capillarity its first scientific foundation; some quotations from his work are recorded.

Also Frankenheim gives Montanari due and ample credit in his "Cohaesionslehre." (See Frankenheim, *Pogg. Ann.*, 72.178.)

4. 1676. BOYLE, ROBERT. New experiments on the superficial figures of fluids, especially of liquors contiguous to other liquors, and their respective powers. *Phil. Trans.*, No. 131, p. 775, or *Phil. Trans. Abridged.* (*J. Lowthorp*,) 1658-1700. Vol. I, p. 525-534, or *Phil. Trans. Abridged*, (*Hutton, Shaw, Pearson*,) 1672-1683, Vol. I, p. 362, or Boyle, *Philos. Works*, (*Peter Shaw*,) Lond. 1738, Vol. I, p. 316 and 388.

Relative to the changes in the shape of the common curvature between liquids in contact with each other, e. g., some Essential Oils, Water, Deliquated Salt of Tartar, Alcohol, Mercury. He also studied the common surface in its behavior towards incidental light.

5. 1683. BERNOULLI, JAC. *De gravitate aetheris* See Buelffinger No. 19.

The air presses on the tubular surface of the water with less force than upon the same area of the surface in the outside vessel, (see Fabri, No. 2.) The author's theory is that the particles of the air occupy space; thus if a row consisting of a definite number, say 7 particles, are just sufficient to fill out the diameter of the tube, and if 8 particles are about to enter its upper orifice, the two extreme ones are barred by the upper edge of the tube, and but six will be admitted. On an equal area of the outside surface the 7 particles can exert their force in opposition, thus exceeding the inside pressure. The narrower the tube, the more pronounced is the exclusion of the air particles.

6. 1686. BORELLI, G. A. *De motionibus a gravitate pendentibus.* Lugd. Bat. 1686. See Buelffinger. No. 19.

Borelli explains the capillary ascent of water by assuming that with the external water there is an excess of energy over that inside the tube. The great inner surface of the latter causes an attractive force which renders the entering water less heavy, as it were, than it is outside. The rise will cease when the inside weight of the water counterbalances the outside pressure.

7. 1700 (about.) HUYGHENS. An attempt to render the cause of that odd phenomenon of the quicksilver remaining suspended far above the usual height in the Torricellian experiment. *Phil. Trans.* No. 86, p. 5027. Or *Phil. Trans. Abridged*, (*J. Lowthorp.*) 1658–1700. Vol. II, p. 23.

Claims that there exists a pressure in addition to that of air, caused by the existence of an all-penetrating subtle matter which acts on the lower end of the mercurial column with its full force, but not so on the upper, as the sides of the glass still offer *some* resistance to the act of penetration. A shock suffices to drop that column to its usual height of 27 inches. Supposed proof of this additional pressure is offered by experiments with ground plates which adhere also in vacuo, and that too even though the lower plate has another weight added.

8. 1705. CARRE, LOUIS. *Mém. Acad. Sc. Paris.* 1705, p. 317. See Buelffinger No. 19. Also Weitbrecht No. 24.

Proves the adhesion of water for glass by experiments with tallow-lined glass tubes.

Among other conclusions he also states that the length of the capillary tube does not influence the height to which water rises in its cavity.

9. 1709. HAUKSBEE, FR. *Physico-Mechanical experiments.* London 1709.

10. 1703–1712. HAUKSBEE, F. An experiment made at Gresham College, showing that the seemingly spontaneous ascent of water in small tubes, open at both ends, is the same in vacuo as in the open air. *Phil. Trans.* No. 305, p. 2223, or *Phil. Trans. Abridged*, (*Hutton, Shaw, Pearson.*) Vol. V, p. 289.

Beside the result indicated in the title, Hauksbee shows that in removing capillary tubes from the fluid, as much will remain suspended in the tubes as rose above the surface of the fluid when dipped into it. He also claims that in order to make a capillary syphon run, the orifice of the longer leg must be at least so far below the surface of the stagnant water, as the water would rise by capillarity in the same tube.

11. 1703–1712. HAUKSBEE, F. Several experiments on the seeming spontaneous ascent of water. *Phil. Trans.*, No. 319 p. 258, or *Phil. Trans. Abridged* (*Hutton, Shaw, Pearson.*) 1703-1712. Vol. V, p. 464.

Describes the ascent of a tinged fluid between 2 glass plates separated by thin layers of paper. in air and in vacuo; fluids rise in thick tubes to same height as in thin tubes of equal bore. The increased power of attraction in narrow tubes is due to the augmented disproportion between the inner area and the cavity. Rise of water studied in a long and wide tube tightly filled with ashes.

First observed the rise of water between two parallel planes of glass or other substances.

12. 1703–1712. HAUKSBEE, FR. An experiment, showing the direction of a drop of oil of oranges between two glass planes towards any side of them that is nearest pressed together. *Phil. Trans.*, No. 332, p. 395, or *Phil. Trans. Abridged*, (*Hutton, Shaw, Pearson.*) 1703–1712. Vol. V, p. 659.

The drop moves towards the side of least distance, with increasing velocity. The latter fact explained by the augmentation of the contact surfaces.

13. 1703–1712. HAUKSBEE, F. An experiment concerning the angle required to suspend a drop of oil of oranges at certain stations between two glass planes, placed in the form of a wedge.

The drop has a tendency to move towards the convergent side of the wedge, but is arrested in its motion when the plate system is raised by a certain angle. Then gravitation counterbalances capillary motion. Numerical relations are given between angle of elevation and distance of drop from center of plates.

14. 1712. TAYLOR, BROOK. Concerning the ascent of water between two glass planes. *Phil. Trans.*, 1712, No. 336, p. 538, or *Phil. Trans. Abridged*, (*Hutton*, *Shaw*, *Pearson*,) 1703–1712, Vol. V, p. 706, or *Phil. Trans. Abridged*, (*Henry Jones*,) 1700–1720, Vol. IV, p. 423.

Was the first to recognize the fact that water which rises between vertical glass plates forming an angle, presents the outlines of an hyperbola. (See No. 15.)

15. 1712. HAUKSBEE, FR. On the ascent of water between two glass planes. *Phil. Trans.*, No. 336, p. 539, or *Phil. Trans. Abridged*, (*Hutton*, *Shaw*, *Pearson*,) 1703–1712, Vol. V, p. 707.

The capillary rise of water between vertical convergent glass planes takes place in the outlines of an hyperbola. Observed the phenomenon almost simultaneously with Brook Taylor, but gives the latter the credit of priority.

16. 1700–1720. JURIN, J. Dr. The cause of the ascent and suspension of water in capillary tubes. *Phil. Trans.*, No. 355, p. 739. or *Phil. Trans.*, (*Henry Jones*,) 1700–1720, Vol. IV, p. 423.

Devising some interesting experiments to prove the assertion that rise and suspension of water in capillary tubes is due to the attraction of the interior annular part of the tube which is above and contiguous to the enclosed water surface. The height of ascent in different tubes is in inverse ratio to the diameters of the tubes. (Jurin's law.)

Jurin's explanation was also adopted by R. Boyle, see "Works" Vol. I, p. 447; the latter there records the ascent of water equal to five inches in very thin glass tubes.

17. 1700–1720. JURIN, J. The action of glass tubes upon water and quicksilver. *Phil. Trans.*, No. 363 p. 1083, or *Phil. Trans.*, (*Henry Jones*,) 1700–1720, Vol. IV, p. 428–435.

By ingenious experiments he refutes certain objections that had been made to his theory. (See No. 16.) Furthermore he ascribes the different behavior between water and mercury in capillary glass tubes to the preponderance of either cohesion or adhesion in each particular case; with water and glass the attraction is greater than that between the water particles; in the case of mercury, the cohesion of its particles is greater than their adhesion to the glass.

18. 1720-33. TAYLOR, BROOK. Measuring the cohesion of water by means of fir-board. *Phil. Trans. Abridged*, (*John Eames*, *J. Martyn.*) Vol. II, p 255.

By means of a balance it was found that 50 grains in weight were necessary to separate each square inch of soaked and well-balanced fir-wood from the surface of water; the force is in proportion to the surface. At the moment of separation the distance of the lower plane of the fir-board from the level of the water was 16-100 of an inch.

19. 1727. BUELFFINGER. De Tubulis Capillaribus Dissertatio Experimentalis. *Comment. Acad. Petropol.* T. II, p. 233-287.

Giving a critical review of preceding literature on Capillarity, viz: By Fabri, Boyle, Carre, J. Bernoulli, Vossius, Borelli, Jurin and others.

20. 1728. JURIN, J. Disquisitiones physicae de Tubulis capillaribus. With notes by G. B. Buelffinger. *Comment. Acad. Petropol.* T. III, p. 281–292.

Rejoinder to Buelffinger, the latter, in his notes, acquiescing in Jurin's views.

21. 1729. MUSSCHENBROECK. *Dissertatio de tubis capillaribus vitreis.* Lugd. Bat. 1729.

Musschenbroeck and other physicists conclude from experiments that the length of capillary glass tubes influences the ascent of water therein. (See No. 59.)

22. 1730. NEWTON, SIR I. *Opticks.* 4th Edition London. 1730. 31st query.

The capillary phenomena observed by Hauksbee, and the observation made by Huyghens of the quicksilver remaining suspended in a barometric tube to the height of 70 inches are adduced as examples to illustrate the various forms of attraction.

23. 1732. SUSSMILCH. I. P. *De cohaesione et attractione corporum.* Jenae, 1732.

24. 1736. WEITBRECHT, J. Tent. theor. qua ascensus aquae in tubis capill. explicatur. *Comment. Acad. Petrop.* T. VIII, p. 261–309.

Coincides with Jurin's views in explaining the cause of water remaining suspended in capillary tubes. (See No. 16.)

As to the phenomenon of *rise*, he inductively shows, that the ascent is the result of the following contending forces:

1)—Attraction between glass and water, causing an aqueous film to form inside, equal in thickness to the diameter of the sphere of attraction.

2)—Cohesion between film particles and remaining water particles, causing aqueous lamels to enter the tube.

3)—Cohesion between the water particles themselves, causing the water to follow the entering lamels, finally resulting in an aqueous "core," connected with the "film" through force No. 2.

4)—Weight of the column.

The rise ends when these forces are in equilibrium.

25. 1737. WEITBRECHT, J. Explicatio difficiliorum experimentorum circa ascensum aquæ in tubos capillares. *Comment. Acad. Petrop.* T. IX, p. 275–309.

Accounts for capillary phenomena in cylindrical and conical tubes and capillary syphons of various shapes.

Applies his theories to similar observations described by Jurin (see No. 17.) and Musschenbroeck. (see No. 21.)

26. 1740. GELLERT, C. E. a) De phaenomenis plumbi fusi in tubis capillaribus. b) De tubis capillaribus prismaticis. *Comment. Acad. Petrop.* T. XI, p. 243a, 252b.

a)—Experiments with melted lead demonstrate that it has the capillary properties of mercury. With both curved and straight tubes of glass or clay of the same bore, the melted lead is depressed to the same depth below the surface.

b) With tubes of prismatic form it is shown that the depression is in reverse ratio to the square root of the cross section of the tube.

27. 1751. SEGNER. *Comment. Societat. Reg. Gotting.* I. 301. 1751.

First made reference to the surface tension of liquids. (Encycl. Brit.)

28. 1756. LEIDENFROST. *De aquae communis nonnullis qualitatibus tractatus.* Duisburg 1756.

Observed the contractile property of soap bubbles, but failed to ascribe it to a generally existing force. (Encycl. Br.)

29. 1770. LALANDE. *Dissertation sur la cause de l'élévation des liqueurs dans les tubes capillaires.* Paris, 1770.

Referred to by several authors, (see Leslie and C. Wolf.)

30. 1773. FUNCCIUS, C. B. *Commentat. II. De ascensu fluidorum in tubis capillaribus.* Lipsiæ 1773.

Funccius is of the opinion that capillary attraction manifests itself only at the place of immediate contact, thus the length of the tube should have no influence on the height of rise. (See No. 50.)

31. 1774. FRANKLIN, BENJ. Stilling of waves by means of oil. *Phil, Trans.*, 1774, p. 445.

Credit given to Pliny for first mentioning the phenomenon. Seamen are quite familiar with it. Franklin calls attention to the amazing swiftness with which a drop of oil spreads on water. From his experience he concludes that oil has a decided tendency to calm the water, but points to some limits of the action.

32. 1780. MORVEAU. *Chemisch-physische Schriften.* Berlin, 1789, p. 334–367.

33. 1784. ACHARD. *Sammlung physikalischer Abhandlungen.* Berlin, 1784, p. 91.

33a. 1786. DUBUAT. *Traité d' Hydraulique.* (1786.)

Was the first to experiment on the flow of liquids through capillary tubes.

34. 1787. MONGE. *Mém. de l'Acad. des Sciences.* 1787, p. 506.

The adherence of the particles of a fluid becomes manifest only at the surface, producing there an elastic membrane whose tension is equal in all directions and may be calculated by mathematical analysis from the primary attraction between any two adjoining particles. This principle is applied to the explanation of the apparent attractions and repulsions between bodies floating on a liquid. (Encycl. Brit.)

35. 1790. ACHARD. Expériences sur l'adhésion des corps aux liquides. *Ann. Chim.* (1) Vol. 7, p. 31-33.

The cohesion of water lessens with rising temperature. Measurements were made by means of counterbalanced plates of glass.

36. 1790. MORVEAU, G. *Ann. Chim.* (1) Vol. 7, p. 32.

Records in figures the force of adhesion between mercury and circular metal disks of one inch diameter after the method of Dr. Taylor. (See Nos. 18 and 35.)
e. g.—Adhesion of mercury for gold—446 grains.
for iron—115 grains.
Concludes that the adhesion between solids and liquids is in proportion to their mutual solubility.

37. 1796. HUTH. Adhaesion von Wasser fuer verschiedene Holzarten. *Gren's neues Journal der Physik.* Vol. 3, p. 299.

It is claimed that there are some differences noticeable in the adhesion of water for different kinds of wood; the adhesion of water seems to be strongest for pinewood and white beech. The average amount is about one pound to the square Rhenish foot.

38. 1797. CARRADORI. Attraction schwimmender Koerper. Communicated by Murhard. *Gren's neues Journal der Physik.* Vol. 4, p. 78.

Small solid bodies floating on a liquid, like the particles of sawdust, attract one another, not by virtue of an inherent attractive force but by the action of the cavity the water forms around them.

Oily bodies have a tendency to expand rapidly on water, especially milk, and the juice of Titimalis and other plants of the order Euphorbiaceæ.

39. 1797. MURHARD. Betrachtung ueber die Schwierigkeit, die bei der Art stattfindet, wie die Newtonianer die Cohaesion der Koerper und die andern dahin gehoerenden Phaenomena erklaeren. *Gren's neues Journal der Physik.* Vol. 4, p. 83-92.

As the force of cohesion between the particles decreases very rapidly with the distance, some apply to this force the law of the *cube* of the distance. But Murhard endeavors to show that the law of gravitation which speaks of the *square* or distance, is sufficient to explain the case of cohesion.

40. 1797. PREVOST, BEN. Sur les émanations des corps odorants. *Ann. Chim.* (1) Vol. 21, p. 254.

Odoriferous bodies when in contact with water produce visible effects thereon: 1) They rapidly move about when thrown on its surface, (like camphor on water, first observed by Romieu.) 2) They repel a thin film of water, which then stays in a circle around the disturbing element. According to Prevost, these phenomena are due to the reaction of the vapors emitted. As "non-odoriferous" bodies, when warm, produce the same effects, they are also said to emanate vapors, which are however imperceptible to man, but often perceptible to animals, for example, dogs. Suggests the construction of an odoroscope to render odors visible.

41. 1797. VENTURI, J. B. Précis de quelques expériences sur la section que des cylindres de camphre éprouvent à la surface de l'eau, et réflexions sur les mouvements qui accompagnent cette section. *Ann. Chim.* (1) Vol. 21, p. 262–275.

Relates and explains the fact that water touching the middle part of a vertical column of camphor will produce within 24 hours a deep incision on this substance; the movements of oily bodies on water are explained on the principle of reaction, likewise the motion of a drop of water on a red hot iron plate, also the strange motions of the network of the fungus Tremella.

42. 1797. PREVOST, BEN. Sur les émanations des corps odorants. *Ann. Chim.* (1) Vol. 24, p. 31-56.

Continuation of No. 40. Substances that are easily volatile, like ether, and camphor, also impart motion to floating bodies when merely approaching the water.

43. 1799. GUYTON. Adhaerenz zwischen Platin und Quecksilber. *Gilb. Ann.*, Vol. 1, p. 572. From *Ann. Chim.*, 1798, p. 1–2.

A platinum dish 2.71 c. m. in diameter in contact with mercury for two days, as the time of contact increased required increasing weights to separate it from the mercury.
1st observation required, 109. grains.
2nd " " 146.2 "
3rd " " 282.25 "

Under like conditions:—Platinum required 282.25 grains.
Bismuth " 372. "
Zinc " 204. "

44. 1799. HASSENFRATZ. Ueber den bisher noch nicht beachteten Einfluss der Adhaerenz auf die Bestimmung des spec. Gew. fester Koerper. Reported by Gilbert. *Gilb. Ann.*, Vol. 1, p. 396. From *Ann. Chim.*, Vol. 1, p. 188.

Hassenfratz claims to have proved by experiments that in taking spec. gravities by means of an areometer, this instrument indicates less than is shown by the spec. gravity bottle. He found the sp. gr. of oil taken by the areometer, 0.9165 and by the gravity bottle 0.9188, and endeavors to sustain his observation by demonstrating that a substance, say glass, after being powdered has a smaller spec. grav. than before. He claims that the adherence of air to the particles of glass does not sufficiently account for diminution of specific gravity, and ascribes this phenomenon to the adhesion of the liquid to the glass, which force increases with the mutually increasing surfaces.

45. 1799. ARNIM, L. A. von. Note to the paper of Mr. Hassenfratz. *Gilb. Ann.*, Vol. 1, p. 423.

Arnim states that Hauksbee in his works (see No. 9, French ed.) explicitly describes observations similar to those of Hassenfratz, (see No. 44.) When weighing in water, two pieces of copper of equal absolute weight, but of greatly different surfaces, the thin piece lost two grains more than the thicker one. As a consequence the spec. gravity of the thinner would be less. Similar observations were made with glass, in bulk and powdered. Finally Hauksbee says: "This phenomenon must be attributed to the same cause that sustains liquids in capillary tubes—attraction."

46. 1799. HERMBSTÆDT and BERTIER. Attractionsversuche. *Gilb. Ann.* Vol. 2, p. 63.

a) A plate of glass, brass or marble, suspended from one end of the beam of a balance, and being in perfect equilibrium is attracted downward by a surface of mercury as soon as they approach within a distance of 1⅓ mm. of each other.

b) Bertier, Hist. Ac. d. Sc. d. Par., 1751, p. 56, demonstrates how different bodies each suspended from a hair are attracted by other bodies held near to them.

47. 1799. BARRUEL. Sur l'élasticité. *Ann Chim.* (1) Vol. 33, p. 100-109 or *Tilloch's Mag.*, Vol. VI, p. 51–65. (1800)

Molecules of bodies are assumed to be surrounded by heat atmospheres which tend to counteract the coherence of the molecules. According to the relative magnitude of both forces, distinction is made between brittle and flexible bodies; the latter class is divided into ductile, soft and elastic bodies.

Liquids are ductile (because the molecules are mobile) and elastic at the same time, (because they transmit sound and rebound upon themselves.)

48. 1800. SCHMIDT, G. G. Einige Bemerkungen und Versuche ueber die vom Buerger Hassenfratz erregten Zweifel gegen die Richtigkeit der gewoehnlichen hydrostatischen Bestimmung des specifischen Gewichtes fester und fluessiger Koerper. *Gilb. Ann.*, Vol. 4, p. 194. (See No. 44.)

By repeating the experiments of Hassenfratz with tin foil, he found the specific gravity different under different circumstances. He comes to the conclusion that the tenacity or inertia of the molecules influences the determination of the specific gravity when made by means of the areometer.

Schmidt found that with an improved Fahrenheit areometer, good results were obtainable.

Provence Oil with the areometer gave 0.9235, with spec. grav. bottle, 0.9202.
Alcohol " " " 0.8135, " " " 0.8135.

49. 1800. COULOMB. Expériences destinées à déterminer la cohérence des fluides et les lois de leur résistance, dans les mouvements très lents. *Mém de l'Institut.*, 1800, Vol. III, p. 246–305.

50. 1800. ARNIM, L. A. Some experiments on the rise of water in capillary tubes. *Gilb. Ann.*, Vol. 4, p. 369.

Contrary to the experience of Weitbrecht, and in conformity with that of Musschenbroeck, Arnim arrives at the conclusion supported by experiments, that the length of the capillary tubes has a decided influence upon the height of rise. The glass tube was shortened by breaking off pieces in succession.

51. 1800. GERSTNER. Versuche ueber die Fluessigkeit des Wassers bei verschiedenen Temperaturen. *Gilb. Annal.*, Vol. 5, p. 160-183.

Gives tabulated results of experiments carried on in order to determine, at different temperatures, the comparative velocity of water running through tubes of equal lengths and equal bore, and by observing the time required for known quantities of water to run out. He concludes that

1) The heat influences the motion of water considerably; e. g., the same quantity of water that runs out of a certain tube in 85 minutes, at 30° R., requires 76 minutes at the temperature of 4° R.

2) The changes in velocity are more pronounced in narrow than in wide tubes.

3) These changes do not take place in proportion to the heat, but have a maximum.

However there are some anomalous results.

52. 1800. CARRADORI, Dr. Sur l'adhésion ou attraction de superficie. Note de Guyton à ce sujet. *Ann. Chim.* (1) Vol. 34, p. 195-199.

Contrary to Morveau's view, adhesion is not the result of chemical affinity, nor can it be brought into any relation to it, because the fatty oils, that indeed have no affinity for water, have an adhesion to its surface, since they spread on the surface of water so rapidly.

53. 1800. CARRADORI, Dr. Sur l'adhésion ou attraction de superficie. Translated by Toilard. *Ann. Chim.*, (1) Vol. 35, p. 87. Also see *Gilb. Ann.*, Vol. 12, p. 108, (1803).

Carradori observed that the juice of Euphorbia (tithymale) which will spread on water rapidly (see No. 38,) does not spread on alcohol, or vinegar. He further observed that certain oils that cover the surface of water may be displaced by other substances that have a greater surface attraction for water than the oils. He gives the following order of displacing power, where each following substance displaces any one preceding from the surface of water. Fixed oils, flour of cereals and leguminous plants, volatile oils, milky juice of plants, especially tithymale.

54. 1800. CARRADORI, Dr. Sur les expériences du cit. *Prevost* de Genève sur la force expansible des émanations odoriférantes, et du cit. *Venturi* de Modène sur les mouvements du Camphre sur l'eau. (Translated by Van Mons.) *Ann. Chim.*, (1) Vol. 37, p. 38. See also *Gilb. Ann.*, Vol. 24, p. 147, (1806).

Contradicts the assertion of Prevost, (see No. 40,) that the recession of the water is due to the repelling power of the vapors emanating violently from the camphor; the reason which Carradori gives, is because the camphor has a greater attraction for the plate than water. He credits Venturi with the same view.

55. 1802. PREVOST, BEN. Sur les mouvements spontanés de diverses substances à l'approche ou au contact les unes des autres. *Ann. Chim.*, (1) Vol. 40, p. 1-32. See also *Gilb. Ann.*, Vol. 24, p. 158, (1806).

Experiments are continued to prove that odoriferous substances impart motions to even heavy bodies floating on water, even though the odoriferous substance may not be in immediate contact with the water. Gives a list of substances, of which each following is displaced by any one preceding, when spread on a clean porcelain dish; from that list we mention here ether, alcohol, peppermint oil, oil of bergamot, fatty oils, pure water, ferrous sulfate, copper sulfate, sodium chlorid, ammonium chlorid.

56. 1802. LESLIE, JOHN. On capillary attraction. *Phil. Mag.* (1) Vol. 14, p. 193.

A drop of water placed upon the under surface of a horizontal plate of glass, spreads upon the latter, forming a thin film. Similarly a drop will partly spread upward when the plate is held vertical. By virtue of such attraction the ascent of water in capillary tubes takes place.

Treating then of various topics bearing on capillarity, Leslie points out that a systematic observation of the capillary rise of different solutions, may prove a useful means to identify them, especially he suggests the construction of a capillary hydrometer for weak alcoholic liquors.

57. 1803. DRAPARNAUD. Sur les mouvements que certains fluides reçoivent par le contact d'autres fluides. *Ann. Chim.*, (1) Vol. 47, p. 303. See also *Gilb. Ann.*, Vol. 24, p. 130, (1806).

Observations regarding the displacement of certain liquids by others in a porcelain dish. Alcohol displaces water. Alcohol displaces olive oil. Orange oil displaces water, but not as strongly as does alcohol. Alcohol displaces ammonia. According to Draparnaud's explanation, there is a repelling power between the liquids that displace each other, while Carradori (see No. 54,) asserts that this behavior of the liquids is determined by the difference in their attraction for the surface of the dish.

58. 1803. HÆLLSTRŒM. Berechnung der mit einer Nadel gehobenen Wassercurve. *Gilb. Ann.*, Vol. 12, p. 625.

Finds the curve to be a catenarian line for which he gives an equation.

59. 1803. HÆLLSTRŒM. Ob das Wasser in laengeren Haarroehrchen hoeher aufsteige als in kuerzern. *Gilb. Ann.*, Vol. 14, p. 425-432.

When sucking out the water from the tubes before every new trial, as supposedly was done by Musschenbrock, (see No. 21,) and Arnim (see No. 50), Haellstrœm obtained conflicting results, but when avoiding it, he obtained the same height of rise whether in long or small tubes. Same conclusion was arrived at by Weitbrecht, (see No. 25.)

60. 1804. BENZENBERG. Gesetz der Cohaesion, ob es von dem der Gravitation verschieden ist, und Kritik der Murhard'schen Gruende. *Gilb. Ann.*, Vol. 16, p. 76.

It is shown by calculation that Newton's law of gravitation sufficiently accounts for the magnitude of the cohesive force, if we only presume the attracting particles to be exceedingly small, and especially take into consideration subdivisions of their minute distances. A table is given from which it is seen, at a glance, how immensely the attractive force increases when two particles approach each other step by step from the distance of an inch down to contact, even though the force of attraction merely obeys Newton's laws of the square of the distance.

Assuming, for instance, such small distances as 86,000 billionth of an inch, and the law of gravitation prevailing, the power necessary to separate two particles, would be the same as the attractive force existing between Venus and Earth equal to 7000 billions of centners.

61. 1804. CARRADORI. Réponses aux objections du cit. Prevost. *Ann. Chim.*, (1) Vol. 48, p. 197.

He reviews Prevost's experiments on the motion of tinfoil on water caused by ether, and other similar experiments. (See No. 42.) Maintains that even in the case of a vapor causing such a motion, this is due not to a repulsion by an elastic fluid, but simply to a surface attraction between the water and the vapors.

62. 1804. CARRADORI. Expériences et réflexions sur les apparentes répulsions entre quelques fluides, observées par Draparnaud. *Ann. Chim.*, (1) Vol. 51, p. 217. See also *Gilb. Ann.*, Vol. 24, p. 134, (1806).

Maintains the same point towards Draparnaud as towards Prevost, that e. g., alcohol displaces water on a porcelain dish, because of its greater attraction for the dish. Draparnaud claims that alcohol repels the water, forming thereby a continuous emission of alcohol particles towards the water finally resulting in its displacement.

63. 1805. YOUNG, THOMAS. Essay on the cohesion of fluids. *Phil. Mag.*, Vol. 1805, p. 65.

Gives here the first complete theory of capillarity, basing it on two axioms:
1) The existence of a surface tension, equal in all directions.
2) The existence of a definite angle of contact appropriate to every combination of a fluid with a solid; when the fluid perfectly wets the solid, the angle is evanescent; for clean mercury and glass it is about 140°.

Thos. Young also shows how the existence of an equable surface tension may be deduced from the assumption that the equilibrium of the particles of a liquid is the result of two contending forces, one repulsive, and another cohesive. (Compare Barruel No. 47.) The essay covers such phases of capillarity as rise of liquids in tubes and between plates, relation between size of drops and height of rise, behavior of mercury, etc.

64. 1805. LAPLACE. Sur l'action capillaire, et Supplément à la théorie de l'action capillaire. *Mécanique céleste*, T. IV, Supplément au X$^{\text{me}}$ livre.

(See Nos. 71, 76 and 77.)

65. 1806. DISPAN. Sur la prétendue attraction de surface entre l'huile et l'eau. *Ann. Chim.*, (1) Vol. 57, p. 14-18. See also *Gilb. Ann.*, Vol. 24, p. 184-188.

Dispan says there is no mutual attraction between oil and water; the particles of the oil are mobile; the reaction of the water forces the drop falling upon it to expand; the outer thin circle experiences friction and finally the cohesion of the oil manifests itself and the oil gathers into a number of smaller drops. The second drop does not spread, because there is too much of an obstacle in its way; however, after a small amount of oil has become diffused, it allows succeeding drops to spread, and so on increasingly.

66. 1806. LINK, H. F. Ueber die Adhaesion tropfbarer Koerper mit einander. *Gilb. Ann.*, Vol. 24, p. 121-128.

Repeating and enlarging upon the experiments of Carradori and others, Link comes to the conclusion that the phenomena of surface attraction, contrary to Carradori's opinion, (see No. 54,) are dependent to a certain degree on chemical affinity. In support of his view, Link adduces the fact that sulfuric acid and alcohol, characterized by their marked affinity for water, repel all oils and resins from the surface of the latter. (See No. 53.)

67. 1806. GILBERT. Einige Streitschriften ueber die Flaechenanziehung (Adhaesion) der Fluessigkeiten unter sich und mit festen Koerpern. *Gilb. Ann.*, Vol. 24, p. 129-188.

Gives a critical review of the polemic papers of Prevost, Venturi, Carradori, Draparnaud and Dispan. (See Nos. 40, 41, 42, 52, 53, 54, 55, 57, 61, 62 and 65.)

68. 1807. YOUNG, THOMAS. Lectures on Natural Philosophy. London. 1807.

69. 1807. RUMFORD, B. GRAF von. Versuche und Beobachtungen ueber die Adhaesion der Wasserteilchen unter einander. *Gilb. Ann.*, Vol. 25, p. 121.

Experiments by Rumford plainly demonstrate the existence of a surface film in water under ordinary conditions. Small particles of heavy substances, like a needle, or fine silver wire, or even drops of mercury will float on water when they first pass through a layer of ether; but will sink without delay upon passing through alcohol. The mercury, when floating plainly rests imbedded in a cavity, separated from the water by a thin film, which seems to be connected with the glass. Rumford finally points out that the existence of a surface tension of the water is of the utmost consequence in the economy of nature. But for the influence of that force the breeze would carry away the water particles mechanically, much more easily than sand which is so readily blown up as dust and every continuous ocean breeze would result in an inundation.

70. 1807. LINK, H. F. Ueber Festigkeit und Fluessigkeit. *Gilb. Ann.*, Vol. 25, p. 133-146.

A liquid is characterized by the great mobility of its smallest particles, because of an almost entire absence of interior friction. Particles within the liquid are in perfect equilibrium since they are attracted (or repelled) equally on all sides by their neighboring particles. But particles composing the surface of the liquid, are attracted downward only, because there are no particles above to compensate for that downward force.

Thus the surface forms a film that is pressing against the interior of the fluid. This condition of the surface resembles the solid state, and some experiences on surface resistance (see No. 69.) strongly favor such a view. Link now argues that the solid condition consists in an interior multiplication of such surfaces, resulting in the formation of fibers and lamels. He declares the liquid condition to be the normal form of matter.

71. 1807. BIOT. On the Theory of Laplace. Reported by Gilbert. *Gilb. Ann.*, Vol. 25, p. 233-254.

The distinguishing feature of Laplace's theory is that all explanations of capillary phenomena are derived from the shape of the liquid surface. In plain surfaces there exists a force of unknown absolute value, pressing in a normal direction against the liquid. When this surface changes to concave, this force becomes less, in proportion to the curvature. When the surface becomes convex, this force increases in the same proportion.

If now a capillary tube be dipped into water or mercury, a concave or a convex meniscus is created respectively; but this meniscus cannot remain on a level with the outside horizontal surface, because in both cases the meniscus pressure is different from the outside surface pressure, exerted in opposite direction; and rise must therefore take place in the case of a concave meniscus, and depression in the case of a convex meniscus in order to equalize the difference in the contending normal forces.

It follows that rise or depression must increase when the curvature of the meniscus increases, that is, when the diameters of the tubes decrease.

Laplace arrives at these results by strictly mathematical reasonings and tests the correctness of his theory by applying it to different capillary phenomena.

72. 1807. LINK, H. F. Fortgesetzte Untersuchung ueber Adhaesion tropfbarer Koerper. *Gilb. Ann.*, Vol. 26, p. 147-151.

Making experiments on the displacement of liquids from solid plates by other liquids, in order to decide between the theory of surface attraction by Carradori and the existence of repellent vapors as presumed by Prevost. (See Nos. 58 and 40.)

73. 1807. TRALLES. Correction by Senkwagen (areometers.) *Gilb. Ann.*, Vol. 27, p. 255.

In determining specific gravities by means of areometers, the liquid when wetting the stem, rises around it, producing a force which exerts a pull downward, thus requiring a correction which may be determined by experiment.

74. 1808. CLAIRAUT. *Théorie de la figure de la terre. Paris*, 1808, p. 105-128.

Clairaut was the first to subject the phenomenon of capillary action to an exact mathematical analysis, (see No. 64.) but his solution of the problem fails to account for the experimental law observed by Jurin. (See No. 16.)

75. 1808. LINK. Ueber Anziehung und Verwandtschaft. *Gilb. Ann.*, Vol. 30, p. 12-22.

Reiterates his theory of the nature of the solid state, (the smallest particles of a solid are supposed to be liquid surfaces, in the shape of lamels or fibers,) (see No. 70.) Solution takes place by the liquid entering the interstices between the lamels, then by virtue of mutual attraction, the surfaces vanish. and the solid becomes fluid. Speed of solution is not always a measure of affinity, as it also depends on the physical conditions of the solvent and the body to be dissolved.

Chemical affinity is manifested sometimes by merely rubbing substances together, e. g., potassium sulfate and lead acetate liquefy under this condition; reversedly, by an intimate mixture of potassium sulfate and calcium chlorid, double decomposition results, neither product being deliquescent.

76. 1809. BIOT. On the Theory of Laplace, II. *Gilb. Ann.*, Vol. 33, p. 117-140.

Reports on Laplace's Supplement to the theory of capillary action (see No, 64,) which is practically a generalization of his former theory. (See No. 71.)

After establishing the law that in prismatic tubes of like nature, of whatever shape, the bulk of liquid raised above the level by capillarity. is in proportion to the inner circumference of their cross sections, Laplace proceeds to verify his theory by applying it to different capillary phenomena. Observations made by Gay Lussac and Hauy are here recorded.

Finally reviewing preceding theories, Laplace acknowledges the close approach of Jurin's view (see No. 16,) to his own theory as laid down in this supplement.

77. 1809. BRANDES and GILBERT. Ueber die Theorie von Laplace. *Gilb. Ann.*, Vol. 33, p. 1-14, 141-182, 275-338, 373-394.

Giving a detailed exposition of the theory of Laplace and of its exemplification by various capillary phenomena. (See Nos. 64, 71 and 76.)

78. 1810. BUSSE. Versuche, um zwischen Cohaesion und Adhaesion zu unterscheiden. *Gilb. Ann.*, Vol. 34, p. 152.

It is presumed that two well polished plates of marble or brass touching each other by their polished surfaces, are held together by two forces which perhaps obey the same law: 1) Cohesion, acting at infinitely small distances, and 2) Adhesion acting at finite spaces. When the plates are moved in a direction parallel to their surface, it is claimed that only the former force is opposing, but when pulled in a normal direction, both forces are to be overcome.

79. 1814. LINK, H. F. Theorie der Fluessigkeit und Festigkeit. *Gilb. Ann.*, Vol. 47, p. 1-43.

The ultimate essence of fluidity consists in the perfect mutual neutralization of the attraction which the particles in the interior of the fluid exert upon themselves. In viscid liquids there is no complete neutralization, and this causes the particles to move less freely. Such a condition approaches the solid state, which becomes especially manifest at the surface of the liquids. (See No. 70.) Link credits Leidenfrost (See No. 28.) with having previously called attention to the solidity of liquid surfaces. Link then gives his views on solidity and electric action, and on various chemical phenomena.

80. 1816. GIRARD. Mouvement des fluides dans les tubes capillaires. *Ann. Chim. Phys.*, (2) Vol. 1, p. 436.

States that Dubuat (see No. 33a,) experimented on the flow of liquids through capillary tubes, and also reviews the work of Gerstner. (See No. 51.) From his own researches he arrives at a quadratic equation expressing the relation between the velocity of outflow, the constant height of the liquid and the length and diameter of the capillary tube. The quantity of outflow under definite conditions varied in the proportion of 1:4 when the temperature varied from 1° to 86° C. These variations he ascribes to the existence of a liquid film, which lines the inside of the tube, and which increases in thickness when the temperature is increasing. Girard calculates the thickness of this film to be not less than 6-10 mm. at 0° C., but at 100° not more than 1-1000 mm.

81. 1816. HACHETTE. Mémoire relatif à l'écoulement des fluides par des orifices à minces parois et par des ajutages cylindriques ou coniques. *Ann. Chim. Phys.*, (2) Vol. 3, p. 78.

Records the changes that take place in the velocity and in the shape of a liquid jet, passing through capillary tubes when the following influences are varying: Diameter, length and shape of the outlet tube, the surface against which it rests, the height and the nature of the liquid in the vessel, and the influence of the surrounding air.

82. 1817. FARADAY. On the escape of gases through capillary tubes. *Quart. Jour. Science*, Vol. III, p. 354.

Desiring to ascertain whether there was any connection between the mobility of gases and their specific gravities, Faraday observed the time which was necessary for different gases to escape through a capillary tube of 20 inches in length, attached to a copper vessel holding 100 cubic inches, during which time the pressure was reduced from 4 atmospheres to 1¼. The result seemed to demonstrate that the relative mobilities of the gases are in inverse ratio to their specific gravities. At low pressures, however, there was no apparent connection between the densities of gases and their passage through narrow tubes.

83. 1817. PETIT. Observations sur les tubes capillaires. *Ann. Chim. Phys.*, (2) Vol. 4, p. 54.

Defends the theory of Laplace against some doubts which were raised by Brunacci in *Giornale di Fisica, Chimica*, etc.

84. 1817. GIRARD. Ecoulement linéaire de diverses substances liquides par des tubes capillaires de verre. *Ann. Chim. Phys.*, (2) Vol. 4, p. 146.

The velocity of motion of a fluid through a capillary tube depends on two distinct influences:

The specific viscosity of the fluids.

The attraction of the material of the outlet tube for the fluid.

The latter influence causes the formation of a liquid film lining the interior of the outlet tube. (See No. 80.) At temperatures below the boiling point, this influence will prevail over the first one. It is shown, for example, that oil of turpentine, and even a syrupy solution of sugar in water require less time to fill a given volume than does alcohol flowing through the same tube at the same temperatures. However, near the boiling point of the fluids, the second influence will vanish, and the viscosity is then probably measurable by the length of time which is necessary to fill a given volume. The fact that mercury flows out equally fast at different temperatures, supports the film theory.

85. 1817. HACHETTE. Sur les veines fluides qui se forment dans les ajutages cylindriques et coniques. *Ann. Chim. Phys.*, (2) Vol. 5, p. 52.

Studied the conditions under which a fluid running through a tube, will fill out this tube, or contract within it thus partly separating from the tube.

86. 1817. PETIT. Lettre relative à la critique de la théorie capillaire. *Ann. Chim. Phys.*, (2) Vol. 5, p. 404.

Concerning the controversy with Brunacci, (see No. 83.)

86a. 1817. EMMETT. On capillary action. *Phil. Mag.*, (2) Vol. 1, p. 115-332. (1817.)

Studied the influence of temperature on capillary phenomena. (See C. Wolf, *Pogg. Ann.*, Vol. 101, p. 550. (1857.)

87. 1817. GIRARD. Sur l' écoulement de l' Ether et de quelques autres fluides par des tubes capillaires de verre. *Ann. Chim. Phys.*, (2) Vol. 6, p. 225-34.

Starting from the proposition that the viscosities of liquids, when they are near their boiling point, are then measurable by the time required for a given amount to flow through capillary tubes, (see No. 84.) Girard finds that the viscosities of ether, water and alcohol at their boiling points, are in the proportion of 80: 107: 300. Thus alcohol proves to be more viscid than water.

Girard further demonstrates that the viscosity of ether and water maintain their proportionality also at lower temperatures, while the viscosity of alcohol increases in a much greater ratio when the temperature decreases.

Finally Girard observed the ascent of ether, alcohol, milk and water in capillary tubes, finding, as he expected, their succession different from their classification according to their specific viscosities.

88. 1819. LAPLACE. Considérations sur la théorie des phénomènes capillaires. *Ann. Chim. Phys.*, (2) Vol. 12, p. 5.

General reflections suggested by his theory on capillarity, (see No. 64,) also demonstrates that Thos. Young's idea of the existence of both an attractive and a repellent (caloric) power between the smallest particles (see No. 68,) is in accord with his own theory.

89. 1819. GIRARD. Mémoire sur les atmosphères liquides, et leur influence sur l'action mutuelle des molécules solides qu'elles enveloppent. *Mém. Ac. R. Sc. Inst. France*, Vol. IV, p. 1-98.

Deduces certain laws from the phenomenon of particles settling within a liquid, advocating the existence of a liquid film surrounding each particle.

90. 1821. YOUNG, THOMAS, Dr. (?) (A letter signed S. B. L.) Remarks on the depression of mercury in glass tubes. *Quart. Jour. Science*, Vol. XI, (1821) p. 83-85.

While rejecting a sweeping statement made by Mr. Ivory in the Encyclopœdia Britannica, which abruptly denied to Thos. Young, all his merits with regard to the theory of capillarity, the latter or his representative points out that in the Encycl. Brit. Suppl., (1819) Art. *Fluids*, edited by Mr. Ivory, there occurred a series of numerical errors in the figures for the depression of mercury in glass tubes.

91. 1821. LAPLACE. Sur l'attraction des corps sphériques, et sur la répulsion des fluides élastiques. *Ann. Chim. Phys.*, (2) Vol. 18, p. 181.

Discusses the attraction one sphere exerts upon another which it surrounds, and gives a theory of the gaseous state, assuming each molecule to be surrounded by a heat atmosphere which counteracts the attraction between each two molecules. From the algebraic formula, which expresses his theory, the laws of Mariotte (Boyle) and of Gay Lussac are readily deducible.

92. 1821. LAPLACE. Eclaircissements de la théorie des fluides élastiques. *Ann. Chim. Phys.*, (2) Vol. 18, p. 273.

A paper, largely embracing theoretical considerations.

93. 1821. NAVIER. Sur les lois du mouvement des fluides, en ayant égard à l'adhésion des molécules. *Ann. Chim. Phys.*, (2) Vol. 19, p. 245.

Navier establishes an elaborate mathematical expression for the velocity of motion of liquids through square tubes, and verifies his result by applying to it the observations made by Girard. (See No. 80.)

94. 1822. LAPLACE. Addition au Mém. sur la théorie des fluides élastiques. *Ann. Chim. Phys.*, (2) Vol. 21, p. 22.

The solid, the liquid and the gaseous conditions are the result of the comparative magnitudes of the following forces:

1) Attraction between each molecule and those surrounding it.

2) Attraction between that molecule and the caloric atmosphere of the surrounding molecules..

3) The repulsion between its own caloric atmosphere and those of its neighboring molecules.

95. 1822. CAGNIARD, DE LA TOUR. Exposé de quelques résultats obtenus par l'action de la chaleur et de la compression sur certains liquides, tels que l'eau, l'alcool, l'éther sulfurique et l'essence de pétrole rectifiée. *Ann. Chim. Phys.*, (2) Vol. 21, p. 127.

When alcohol or petroleum ether or sulfuric ether are inclosed in a strong glass tube, and fill not more than half its volume, the liquid expands upon being heated, until it occupies about double its former space; when now the heat increases, the liquid disappears and the tube contains the vapor. Upon cooling, clouds appear inside the glass, and the liquid is formed again. In similar experiments with water, difficulty arises in that water corrodes the glass, impairing its transparency.

96. 1822. CAGNIARD, DE LA TOUR. Supplement to the former memoir. *Ann. Chim. Phys.*, (2) Vol. 21, p. 178.

Cagniard found that ether completely volatilizes in closed glass tubes at 160° C, exerting a pressure of 37-38 atmospheres, and alcohol at 207° C, exerting a pressure of 119 atmospheres. Water seems to completely volatilize at the temperature of melting zinc, (433° C.) A vacant space in the containing glass had to be allowed in each case for the expansion of the liquid prior to its volatilization.

97. 1822. FISCHER, N. W. Ueber die Eigenschaft der tierischen Blase, Fluessigkeiten durch sich hindurch zu lassen. *Gilb. Ann.*, Vol. 72, p. 300.

The property of animal membranes to be permeable for liquids was discovered by Fischer in 1812. Here he makes some general statements as to the conditions under which liquids pass through such membranes. He mentions, for example, that the duration of passage depends to a great extent on the nature of the membrane; thus, the sheep's bladder, although very thin, is not very permeable by liquids; only to about the same extent as that of oxen.

Fischer then describes the following striking phenomenon: A tube closed at the bottom by a bladder, and containing water and an iron wire, was placed in a solution of a cuprous salt, the level of the latter solution being higher than that of the water. The latter then rose to four inches above the outside level, while copper was deposited inside by the iron wire. In modifications of this experiment it was shown that rise took place only in case a chemical reaction was involved.

98. 1823. DOEBEREINER. Remarks on capillary action of fissures. (Communicated by Liebig.) *Ann. Chim. Phys.*, (2) Vol. 24, p. 332.

Relates his well-known experience where hydrogen which was kept over water in a bell jar, escaped through a crack in the glass, causing the water to rise inside to more than one-third of the interior volume. Oxygen, nitrogen and air did not show this behavior, which is due, according to Doebereiner, to the smallness of the atoms of hydrogen, which are at the same time surrounded by atmospheres of heat of much greater energy than those surrounding the atoms of other gases.

Doebereiner furthermore alludes to the experiments of Faraday (see No. 82,) and of Dr. Soemmering, who demonstrated that dilute alcohol may be concentrated by allowing it to stand in a glass with a bladder tied over its mouth; the vapors of water seem to pass through the pores of the bladder more readily than the vapors of alcohol.

99. 1823. BECQUEREL. Des courants électriques qui ont lieu dans les actions capillaires. *Ann. Chim. Phys.*, (2) Vol. 24, p. 337.

Becquerel observed that electric action takes place even in cases where chemical affinity is out of question, and concludes that capillary action produces electric currents. Platinum sponge or charcoal absorbing diluted acid, even the mere dipping of platinum foil into dilute acid, causes the needle of a fine galvanoscope to be deflected. The same phenomenon takes place when solid or liquid acids, or alkalis, or neutral salts are dissolved in water. Intensity and direction of the current is dependent on the conditions.

100. 1825. GILLEROU. On a singular capillary phenomenon. *Quart. Jour. Science*, Vol. XIX, p. 135.

A capillary column of mercury, which usually stands below the outside mercurial surface, may be raised above this level by most carefully raising the tube which contains it. The curvature of the surface of the column changes on its way from convex to concave. But upon lowering the tube now a little, the surface of the column becomes convex, although it still stands above the level. Gillerou therefore concludes that the curvature of a fluid is but an accessory circumstance and does not determine the nature and height of capillary rise or depression.

101. 1825. GIRARD, T. S. On the attraction manifested at sensible distances by solid surfaces moistened by, or immersed in, a liquid. *Quart. Jour. Science*, Vol. XX, p. 379. Also see *Ann. Chim. Phys.*, (2) Vol, 29, p. 260.

Girard suspended two glass plates of equal size in water opposite to each other and imparted to each the motion of a pendulum. He then recorded the average time of one-half oscillation when the plates were reasonably apart. Now they were brought within such small distances (defined by intervening thin wires of known thickness) as to bring into mutual penetration the liquid layers assumed to exist upon the surface of each plate.

Measurements then demonstrated that the oscillating motion of the plates was manifestly retarded, which became the more evident the thinner a wire was employed. Therefrom Girard concludes that plates which are suspended near each other in a parallel position in liquids which are capable of wetting them, are perceptibly attracted by virtue of a power acting at finite and measurable distances, and emanating from the strata of liquid condensed upon the surfaces of the plates.

102. 1826. DUTROCHET. On Endosmosis. *Journal de Pharmacie*, (1826)

First account of that phenomenon.

103. 1826. LINK, H. F. Ueber die Festigkeit der Koerper. *Pogg. Ann.*, Vol. 8, p. 25-37, 151-164, 283-298.

104. 1826. FARADAY. Ueber die Aufbewahrung von trocknen Gasarten ueber Quecksilber. *Pogg. Ann.*, Vol. 8, p. 124.

Three specimens of carefully dried oxy-hydrogen gas were kept for 15 months over mercury in glass bottles which were closed with well ground stoppers. and invertedly placed into a vessel containing sufficient mercury to reach to the neck of the bottles.

Examination of their contents after 15 months revealed the fact that one contained air, and the other mixtures of air and oxy-hydrogen gas. Faraday concludes that the air must have entered between the mercury and the glass, and thus proved that gases which are kept over mercury in glass tubes are liable to escape thorough the small space between the mercury and the walls of the glass.

Poggendorff adds in a note that this phenomenon may be referred to the same cause as that observed by Doebereiner. (See No. 98.)

105. 1827. MAGNUS, G. Ueber einige Erscheinungen der Capillaritaet. *Pogg. Ann.*, Vol. 10, p. 153.

Magnus is the author of an interesting experiment, which in a modified form, is mentioned by Tait (see later) viz., that the evaporation of water from the surface of an animal membrane, tightly fitting over the top of a glass tube, can draw upward a considerable column of mercury (three inches in these experiments.)

To such an evaporation he likens the escape of hydrogen through fissures in Doebereiner's experiments. (See No. 98.)

Pronouncing the action of animal membranes to be a capillary phenomenon, and alluding to the discovery of the membrane phenomena (endosmosis) by Dutrochet, (see No. 102.) he observes that water passes through the pores of a bladder more easily than salt solution, which explains why the rise invariably occurs in those tubes containing the brine. On this basis he gives a complete explanation of the phenomenon described by Fischer, (see No. 97.)

106. 1827. FISCHER, N. W. Ueber das Verhalten der Risse in Gläsern zu den darin enthaltenen Flüssigkeiten. *Pogg. Ann.*, Vol. 10, p. 481.

Makes distinction between the effects of wide and narrow fissures. He observed that the very narrowest fissures did not allow any interchange of liquids, except in one case on record, where silver nitrate was kept in the fissured glass which was standing in water; the latter afterwards showed no trace of silver by means of delicate tests; but the electric current deposited traces of silver in the inside vessel and formed zinc or copper nitrate in the outside glass.

107. 1827. FISCHER, N. W. Capillarwirkungen der tierischen Blase. *Pogg. Ann.*, Vol. 11, p. 126.

Confirming in general the results obtained by Magnus, (see No. 105.) he records among other observations the fact that the action of water through a membrane is especially remarkable towards cupric chlorid, but insensible towards silver nitrate, gold solution and stannous chlorid, because these solutions are reduced or decomposed during the operation.

With reference to Magnus' experiment on the rise of mercury caused by evaporation of water, (see No. 105.) Fischer states that evaporation of water may draw up the mercury much higher than three inches, probably to the height of the mercury in the barometer, provided that the space immediately below the bladder is filled with water.

Fischer further remarks that alcohol does not readily penetrate a bladder, which sufficiently explains the observation of Soemmering. (See No. 98.)

108. 1827. POISSON. Note sur les effets qui peuvent être produits par la capillarité et l'affinité des substances hétérogènes. *Ann. Chim. Phys.*, (2) Vol. 35, p. 98-101. Also see *Pogg. Ann.*, Vol. 11, p. 134.

He accounts for the phenomenon of endosmosis by supposing the pores of the membrane to act as capillary tubes. Of two liquids on opposite sides of a membrane, the one which would rise higher in a capillary tube of the same material as the membrane would also pass into the other liquid. His explanation, however, fails to recognize the existence of the current in opposite direction.

109. 1827. DUTROCHET, HENRI. Nouvelles observations sur l'endosmose. *Ann. Chim.*, (2) Vol. 35, p. 393-400. See also *Pogg. Ann.*, Vol. 11, p. 138.

Dutrochet holds that the flow of liquids in both directions through membranes speaks against Poisson's theory. (See No. 108.) He further finds that while in the case of water and other liquids, the change of level takes place in conformity with the superior capillary rise of water, in other cases (oil of lavender, alcohol of 36° Be., olive oil.) the flow occurs contrary to what should be expected from the observed capillary ascents. Poggendorff in a note points out the probable fallacy of the latter experiments. Dutrochet remarks that these phenomena may also be observed with porous thin plates of inorganic material, and finally emphasizes the bearing which endosmosis has upon physiological processes.

110. 1828. IVORY. On the Theory of Capillary Action, and the Depression of Mercury in the tubes of Barometers. *Phil. Mag.*, Vol 3, (or 5 ?) p. 1-11.

111. 1828. MUNCKE, G. W. Ueber Leidenfrost's Versuch. *Pogg. Ann.*, Vol. 13, p. 235.

Here the following literature on the subject is recorded: Leidenfrost (see No. 28.) Klaproth, *Allg. Jour. Chem.*, Vol. 7, p. 646. Rumford, *Gilb. Ann.*, Vol, 17, p. 88, Doebereiner, *Schweigger's Journ.*, Vol. 29, p. 43, or *Gilb. Ann.*, Vol. 72, p. 211, and Vol. 87, p. 447.

112. 1828. DUTROCHET. Nouvelles recherches sur l'endosmose et l'exosmose. *Ann. Chim. Phys.*, (2) Vol. 37, p. 191.

Makes use of his Endosmometer to render the osmotic action visible. When water is placed in the outside part of this instrument, and an aqueous liquid miscible with water, (e. g. a solution) inside, water invariably passes the membrane in greater quantity than the inner liquid does in opposite direction. Hence the latter rises in the stem.

113. 1830. PRECHTT. On the Adhesion of Metals. *Quart. Jour. Science*, (2) Vol. 7, p. 196.

Prechtt observed that, if two plates of copper adhere with a force of 21 grains, then one of these copper plates will adhere to a similar plate of bismuth, zinc, tin, or lead, with the same force, although two plates of any of these latter metals will adhere with less force.

114. 1830. POISSON. Mémoire sur l'équilibre des fluides. *Mém. de l'Acad. des Sciences*, Vol. 9, p. 1-88. (1830) See also *Quart. Jour. Science*, (3) Vol. 1, p 595.

Arriving at several equations pertaining to the equilibrium of fluids, he contends that capillary phenomena are due to molecular action, resulting from both an attraction and repulsion by caloric atmospheres, and modified not only by the form of the surface, as maintained by the theory of Laplace, (see No. 64,) but also by a peculiar state of compression of the liquid within its surface film.

115. 1830. GAUSS. Principia generalia theoriae fluidorum in statu aequilibrii. *Comment. Soc. Gotting.* Vol. 7, p. 39-83. See also *Gauss' Werke*, Vol. 5, p. 29-77, (1877).

Gauss arrived at the equation of Laplace for the capillary surface of a liquid, but approached the subject from a broader principle, that of the conservation of energy. Further details cannot be given here, as they involve the extensive use of purely mathematical terms.

116. 1830. FISCHER, N. W. Leidenfrost's Versuch. *Pogg. Ann.*, Vol. 19, p. 514.

Fischer thinks that Leidenfrost's Phenomenon, in the case of water, consists in a decomposition into Oxygen and Hydrogen, induced by heat, and in their spontaneous recombination, aqueous vapors being formed.

117. 1831. POISSON. Nouvelle théorie de l'action capillaire. *Ann. Chim. Phys.*, (2) Vol. 46, p. 61-70.

Gives a brief review of the mathematical development up to his time of the theory of capillarity embracing the theories of Clairaut, Thomas Young, Laplace and Gauss. He claims the theories of Laplace and Gauss to be deficient in that they do not take into account the variation in density of a liquid near its free surface and near their surface of contact with a solid body. (See No. 114.) On these premises he announces his "Nouvelle théorie" to be established.

118. 1831. POISSON. *Nouvelle théorie de l'action capillaire.* Paris, 1831.

The purpose of this work is to rectify an alleged omission in all preceding theories of capillarity, by evolving an equation for the capillary surface of a liquid, at the same time taking into account the variation in density near its surface and near its contact with a solid body. (See No. 117.) Poisson claims that if this point is ignored, the theory would neither lead to capillary elevation nor depression. Subsequent chapters give a mathematical treatment of various capillary phenomena, evolved on the same basis.

In Notes and Additions he gives his views of the molecular constitution of matter, especially liquids, (see No. 114,) also some experimental material, such as the capillary behavior of mixtures, and the depression of Mercury in capillary tubes, recording Dulong's theory. (See No. 124.)

119. 1831. DUTROCHET, HENRI. Expériences sur la circulation des liquides dans les tubes de verre verticaux. *Ann. Chim. Phys.*, (2) Vol. 48, p. 268-281.

Water contained in a vertical glass tube exhibits a circulating motion when different temperatures are applied to opposite sides of the glass. At or above 15° R. the motion responds readily to slight thermal differences; at or below 10° R. there was no motion observed even when the change in temperature was 5°. Addition of Acids, Alkalies and Salts increased the sensibility, also diffused light seemed to have a decided influence on the motion of pure water.

120. 1832. DUTROCHET, HENRI. Recherches sur l'endosmose et sur la cause physique de ce phénomène. *Ann. Chim. Phys.*, (2) Vol. 49, p. 411. Also see *Pogg. Ann.*, Vol. 28, p. 459.

Studying the osmotic action of water towards solutions of Sodium chlorid and Sodium sulfate of equal densities, he found the ratio of their osmotic velocities equal to exactly 1:2. An exactly parallel relation he thinks to exist between the capillary rise of both liquids and of water in the same glass tube.

In *Pogg. Ann.* a critical report on this paper is given.

121. 1832. DUTROCHET, HENRI. Du pouvoir d'endosmose considéré comparative dans quelques liquides organiques. *Ann. Chim. Phys.*, (2) Vol. 51, p. 159. Also see *Pogg. Ann.*, Vol. 28, p. 359.

Preparing solutions of Gelatine, of Gum arabic, of Sugar, and of Albumen, all of equal density, and determining the velocity of endosmosis of water towards them severally, he finds the osmotic power increasing in the following order:

Gelatine; Gum; Sugar; Albumen; the relation between Gelatine and Albumen being as 1:4.

122. 1832. BUFF, H. Leidenfrost's Versuch. *Pogg. Ann.*, Vol. 25, p. 591.

Buff sees in the phenomenon the natural effect of heat, which counteracts adhesion between fluid and solid by increasing the distance between their molecules. Absence of adhesion hinders the passage of heat from the glowing surface to the fluid, hence evaporation is retarded. If chemical affinity exists between both, the contrary takes place.

Buff finally verifies and discusses Perkin's experiment (described in No. 111,) in which it was demonstrated that water and steam contained in a vessel with red hot walls will not escape through a small opening at the bottom of the vessel.

123. 1832. BESSEL. Beobachtungen in Bezug auf die Capillarität beim Barometer. *Pogg. Ann.*, Vol. 26, p. 451-455.

Bessel observed that the meniscus of Mercury in the longer arm of a barometer gradually diminished and even became concave. During this change air had collected above the mercury. After expelling this air. the meniscus became strongly convex, and the mercurial height was considerably lessened, seemingly more than if capillarity alone had been the cause.

124. 1832. DULONG. Beobachtungen in Bezug auf die Capillarität beim Barometer. *Pogg. Ann.*, Vol. 26, p. 455-458. from Poisson, *Nouv. Théorie*, (see No. 118).

The phenomenon of Mercury adhering to glass in freshly made barometers, observed by Dom. Casbois, he explains by the theory that during the boiling, Mercuric Oxid is formed which greatly modifies the action between Mercury and glass.

When Mercury is boiled in an atmosphere of Hydrogen, no such phenomenon is noticeable.

125. 1832. BOHNENBERGER. Beobachtungen in Bezug auf die Capillarität beim Barometer. *Pogg. Ann.*, Vol. 26, p. 458-463.

Determined experimentally the capillary depression of Mercury in barometric tubes of different diameters, in comparison with a normal barometer. An addition of 1-60 per cent. of Silver to Mercury renders the mercurial surface less convex and diminishes the capillary depression. Air seems to have a depressing influence on Mercury in barometric tubes.

126. 1832. MAGNUS, G. Ueber die Verdunstung von Flüssigkeiten aus Haarröhrchen. *Pogg. Ann.*, Vol. 26, p. 463.

By placing several tubes of different widths, open on top, and each filled with water to a certain mark, under the receiver of an air-pump, containing a dish with sulfuric acid, it was found that evaporation did not take place in proportion to the free surfaces of the water, but that the column of water decreased more rapidly in capillary than in wider tubes.

127. 1832-33. LINK, H. F. Darstellung von Poisson's Theorie der Capillarität. *Pogg. A.nn*, .Vol. 25, p. 270-287, (1832). Vol. 27, p. 193-238, (1833).

The first part contains a critical comparison between Poisson's and Laplace's theories. The second a detailed exposition of Poisson's Nouvelle théorie, (see No. 118). Pronounces Poisson's theory of the variation in density to be an arbitrary assumption which he asserts we will never be able to verify.

128. 1833. LINK, H. F. Neue Versuche über die Capillarität. *Pogg. Ann.*, Vol. 29, p. 404-414.

By using plates of glass, copper, zinc, etc., placed at an angle to each other, he observed the height to which different liquids (Water, Sulfuric and Nitric Acids, Alcohol, Ether,) rose at the line of approach. The height seemed to be the same in all cases. (See No. 129.)

129. 1834. LINK, H. F. Neue Versuche über die Capillarität. *Pogg. Ann.*, Vol. 31, p. 593-599.

Records the fact that water rises to the same height between parallel plates of copper, zinc or glass. The following liquids are named in declining order with regard to the height to which he observed them to rise between parallel and equidistant plates, viz: Strong Acids, Water, Caustic Alkali, Potassium Acetate, Alcohol, Ether.

130. 1834. GRAHAM, TH. On the Law of the Diffusion of Gases. *Phil. Mag.*, (3) Vol. 2, p. 175-190, 269-276, 351-358. See also *Pogg. Ann.*, Vol. 28, p. 331-358.

Starting from Doebereiner's observation, (see No. 98,) he evolves the following law of diffusion: When two gases without chemical effect upon each other, are separated by means of a porous membrane, the volume of the one gas passing through this membrane stands to the volume of the other gas passing in the opposite direction, in inverse ratio as the square roots of the densities of both gases, provided the pressure on both sides of the membrane remains the same.

131. 1834. DRAPER, J. M. Some experimental researches to determine the nature of capillary attraction. *Franklin Inst. Jour.*, Vol. 14, p. 147-165.

From many conclusive experiments (e. g. the generation of electricity by the simple act of separating a glass dish from a surface of Mercury,) the author infers that capillarity is mainly an electrical phenomenon. (See No. 99.) With regard to Huyghen's phenomenon (see No. 7,) he demonstrates that electric discharges are taking place, whenever the mercury drops from its unusual height to its normal level. He also seeks to explain the phenomenon of osmosis and various physiological phenomena by the electrical theory.

132. 1835. JERICHAU, E. B. Ueber das Zusammenströmen flüssiger Körper, welche durch poröse Lamellen getrennt sind. *Pogg. Ann.*, Vol. 34, p. 613.

Water and sugar solution contained in a U tube and separated by means of a drop of mercury, will pass into each other (the water with greater velocity) through the space between the mercury and the glass. (Compare No. 104.)

When using membranes, there is always a flow in both directions, but a general law, like that of Graham for gases, (see No. 130,) was not observable for solutions. Nor could a definite relation be observed between osmosis and capillarity as it was supposed to exist by Dutrochet. (See No. 120.)

133. 1835. FRANKENHEIM, M. L. *Die Lehre von der Cohæsion*, Breslau, 1835.

134. 1835. CHALLIS, Rev. JAMES. Report on the Theory of Capillary Attraction. *Brit. Assoc. Report*, Vol. 4, p. 253-294.

The review comprises an historical introduction, and subsequently a detailed exposition of the works of Th. Young, Laplace, Poisson, Gauss and Link. (See Nos. 68, 64, 118, 115, 128.)

135. 1836. FRANKENHEIM, M. L. Ueber die Cohäsion der flüssigen Körper. *Pogg. Ann.*, Vol. 37, p, 499.

Gives a table which contains the constants of capillarity for a number of liquids, e. g., water, aqueous solutions of acids, alkalies and salts, also ethers and volatile oils.

136. 1836. DRAPER, J. W. Experiments on Endosmosis. *Franklin Inst. Jour.*, Vol. 17, p. 177-182. Vol. 18, p. 27-31.

The phenomena of osmosis applied to gases, become the more pronounced, the smaller the pores of the intervening medium. This the author demonstrated by using films of gold leaf and of india rubber, and finally liquid films, these being the most suitable media, because by varying the thickness of the film, the speed of osmosis may be regulated at will. Interesting experiments are adduced to illustrate this point. The motion through a barrier ceases when there is identity of chemical composition on both sides.

137. 1836. DEGEN, F. Versuche über die Netzbarkeit der Oberfläche verschiedener Körper. *Pogg. Ann.*, Vol. 38, p. 449.

Heat according to the author's experiments is a proper means to produce the wetting of solids by liquids. He concludes that the adhesion of the air to the solid is often responsible for its not being wetted by the liquid.

138. 1837. BAUDRIMONT, A. Explication du phénomène que l'on observe en versant de l'eau sur des corps chauffés jusqu' au rouge. *Ann. Chim. Phys.*, (2) Vol. 61, p. 319.

Baudrimont determines among other points the temperature of the liquid in the red hot vessel, and observes that the temperature of boiling water decreases when poured into such a vessel. He finally pronounces the phenomenon to be simply a process of slow evaporation. (See No. 140.)

139. 1836. CHALLIS, Rev. JAMES. On Capillary Attraction and the molecular forces of fluids. *Phil. Mag.*, (3) Vol. 8, p. 89.

The author endeavors to show that the superficial variation of density in liquids (see No. 117,) may be neglected and Laplace's Theory of incompressibility upheld, if it is assumed that the fluid molecules possess both a feebly attractive and a strongly repellent force. The repellent power however extends over a small, the attractive power over a much larger, yet immeasureably small area. Such a molecular constitution allows an easy explanation of the fluid condition.

140. 1836. CHALLIS, Rev. JAMES. On the Phenomena of drops of oil floating on water. *Phil. Mag.*, (3) Vol. 8. p. 288.

Explains the phenomenon of oil spreading on water by applying thereto his theory on fluidity. (See No. 139.)

141. 1836. LAURENT, AUGUSTE. Phénomènes que présente l'eau versée sur des corps chauffés au rouge, et sur quelques illusions d'optique. *Ann. Chim. Phys.*, (2) Vol. 62, p. 327.

Contrary to the observations of Baudrimont, (see No. 138,) who found the temperature of the drop of water in the red hot crucible to be not more than 50° C, Laurent observed 99°, by direct measurement (dipping a thermometer into the liquid,) not less than 95° C. Slow evaporation takes place when no wetting occurs, and rapid evaporation in the opposite case. The fluid touches only a few points, evaporation throws the liquid upward, causing it to vibrate and rotate, and to form symmetrical figures. (See No. 195.)

142. 1837. AVOGADRO. Expériences sur quelques points douteux relatifs à l'action capillaire. *Ann. Chim. Phys.*, (2) Vol. 65, p. 409-443,

Experimental researches, undertaken with the aim to verify or correct the values for the constants of capillarity of Mercury, as found by Gay Lussac (see No. 64,) and Poisson. (See No. 118.)

Avogadro determined the height of rise of Mercury in amalgamated tubes, and the angle which Mercury forms with moistened and dry glass tubes, and with Iron and Platinum, showing that the latter metal forms a greater angle with Mercury than Glass and Iron.

143. 1838. DUPREZ, F. Description of a phenomenon taking place upon mixing Alcohol and Water. *Bull. Acad. Roy. Belg.*, (1) Vol. 5, p. 402.

When one or two drops of alcohol are added to water in a test tube, air bubbles arise in the liquid, forming a surface scum. Soon afterwards a fine jet of bubbling liquid comes out of the surface, sometimes as high as 3 centimeters. The motion gradually lessens and disappears.

144. 1838. DRAPER. Ein Diffusionsversuch. *Pogg. Ann.*, Vol. 43, p. 88. Also see *Philos. Mag.*, (3) Vol. 11, p. 559.

Place a film of viscid soap lather over the mouth of a 2 ounce vial; place over this vial a jar of Nitrous Oxid; in a few seconds the horizontality of the film will be disturbed, it will become convex, and at the end of 2 minutes it will form the greater part of a sphere 2 inches in diameter exhibiting brilliant colors.

145. 1838. MILE, J. Versuch einer neuen physika schen Theorie der Capillarität. *Pogg. Ann.*, Vol. 45, p. 287-332 A) and 501-540 (B) See also *Lieb. Ann.*, Vol. 32, p. 191, (1839).

A)—In a liquid bounded by a plane surface the molecules are supposed to exist in an arrangement similar to that of a pile of cannonballs, each central ball environed by twelve others, their mutually attractive and repellent forces being in equilibrium. Any mechanical deformation of the surface changes the distances between the molecules, and calls into existence a tendency of the fluid to resume the plane surface.

On this principle, a free liquid mass, not inclosed in a vessel, (e. g. a drop) must assume the globular form, that is, bounded by an infinitely great number of planes. Similarly the formation of bubbles may be explained, and the surface of a drop or of a bubble must exert an inward pressure, the surface tension. By virtue of this tension depression and rise take place in capillary tubes, depression corresponding to the formation of a drop, and rise to that of a buble. (See No. 71.)

B)—By assuming capillary repulsion preponderant over attraction, the author here accounts for certain thermal capillary phenomena, such as the fugitive motion of water in a horizontal tube, if heated at one end; also for the repulsion observable between Water and Alcohol, and a multitude of other phenomena.

146. 1840. EMSMANN, A. H. Bildung des Leidenfrost'schen Tropfens auf Glas. *Pogg. Ann.*, Vol. 51, p. 444.

Emsmann demonstrates the phenomenon by using a narrow glass tube ending in a bulb containing water, which is briskly heated over a lamp. He also observes that the water is not decomposed in the process. (See No. 116).

147. 1840. BUFF, H. Ursache des veränderlichen Einflusses der Capillarität beim Barometer. *Lieb. Ann.*, Vol. 36, p. 113.

His experiments tend to support Dulong's view, (see No. 124.) Upon repeatedly boiling mercury in barometric tubes and admitting the air, red Oxid of Mercury was seen to be formed, the meniscus became flat and adhered to the glass, even when near the boiling point. Boiling in an atmosphere of Carbonic Acid gas did not materially affect the curvature of the meniscus; but boiling the mercury with some Oxid of Mercury in a current of Carbonic Acid gas caused the meniscus to become concave after cooling.

148. 1840. KOPP, H. Ueber die Cohäsion einiger Flüssigkeiten. *Lieb. Ann.*, Vol. 35, p. 230-234.

Determined the cohesion of Water, Alcohol and Rape Oil by the force necessary to tear asunder a known surface of either of these liquids. Instead of using the customary adhesion plates, he suspended from one arm of a balance a small bell jar of known dimensions, filled with the liquid dipping into a reservoir containing the same liquid.

149. 1840. RUSSELL, J. S. On Floating Bodies. *Proc. Roy. Soc. Edinbg.* Vol. 14, p. 47-109.

The aim of the investigations, which were conducted on the largest possible scale, was to determine the laws between the velocity of motion of floating bodies and the resistance of the fluid, and to apply the results to the purposes of navigation.

150. 1841. HENRY. Durchdringung des Bleis von Quecksilber. *Pogg. Ann.*. Vol. 52. p. 187.

Henry succeeded in transferring Mercury from an upper watchglass to another below, by means of a solid rod of lead, ¼ inch thick, bent in the shape of a syphon. In 5 to 6 days all the mercury had passed, and thus must have traversed the capillary interstices of the rod of lead.

151. 1841. OERSTED, J. C. Eine neue Vorrichtung zum Messen der Capillarität. *Pogg. Ann.* Vol. 53, p. 614.

The apparatus consists essentially of a non-capillary U tube, one arm of which is capped by a plate containing the capillary bore. The latter is then capable of suspending a liquid column whose height is equal to the distance from the lower surface of the plate to the level of the liquid in the other arm of the U tube.

152. 1841. SIMON, (de Metz). Recherches sur la capillarité. *Comptes Rendus,* Vol. 12, p. 892-94. (See No. 202.)

153. 1841. FRANKENHEIM and SONDHAUSS. Ueber die Capillarität der flüssigen Körper bei verschiedenen Temperaturen. *Erdmann's Journal,* 1841, p. 401-245.

The authors record the specific gravities and corresponding constants of capillarity of the following liquids at varying temperatures: Water, Alcohol of different strengths, Ether, Carbon disulfid, Sulfuric Acid and Caustic Potash. The capillarities decrease at a greater ratio with the temperature than do the specific gravities, which contradicts part of Laplace's theory. (See No. 64).

154. 1842. PLATEAU, J. Ueber die Erscheinungen bei einer freien und der Wirkung der Schwerkraft entzogenen Flüssigkeit. *Pogg. Ann.*, Vol. 55, p; 517-519. From *Bull. Acad. Brux.*, Vol. 9, p. 17.

The author's well-known experiment is here recorded wherein he demonstrates that a mass of oil suspended in a mixture of alcohol and water of equal density, assumes the globular form, and becomes flattened into an ellipsoidal body by rotation.

155. 1842. PLATEAU, J. Ueber die Erscheinungen bei einer freien und der Wirkung der Schwerkraft entzogenen Flüssigkeit. *Pogg. Ann.*, Vol. 56, p. 167-169.

Continuing his fundamental experiment (see No. 154,) the author observes the rise of the oil in wide tubes dipped into the oil globule and indicates precautions necessary in order to succeed in this experiment.

156. 1842. BIEWEND, E. Ein Adhäsionsphänomen. *Pogg. Ann.*, Vol. 57, p. 164.

Globules of freshly melted gold, chemically pure, also alloys with silver containing 50 per cent. gold, were seen to adhere strongly to one another, losing this power upon prolonged exposure to the air; pure silver did not show this phenomenon.

157. 1842. BEEK, A. VAN. Eigenschaften des Oels, die Meereswogen zu besänftigen und das Wasser durchsichtig zu machen. *Pogg. Ann.*, Vol. 57, p. 419-452. Also see *Ann. Chim. Phys*, (3) Vol. 4, p. 257.

Gives numerous historical references, most of which proclaim the efficacy of oil in pacifying the waves. (See No. 81.) He suggests the use of oil for the purpose of protecting the dams and dikes in Holland against the erosive influence of stormy seas.

158. 1842. BRAVAIS. Nouvelles tables des dépressions de mercure dans les tubes du baromètre. *Ann. Chim. Phys.*, (3) Vol. 5, p. 492-508.

A final table records the depression of Mercury for tubes of different diameters ranging from 4 to 20 mm, and for an angle of contact between Mercury and Glass, varying from 15° to 48°.

159. 1842. DUTROCHET, HENRI. Observations relatives à l'action motrice exercée sur la surface de plusieurs liquides tant par l'influence de la vapeur de certaines substances que par le contact immédiat de ces mêmes substances. *Comptes Rendus*, Vol. 14, p. 1028-1042 (2) and Vol. 15, p. 15-28.

A drop of Ether suspended over concentrated Sulfuric Acid covered with flowers of Sulfur, will attract the powder. But when the acid is diluted below a specific gravity of 1.546 (equivalent to 2 Vols. of acid and 1 Vol. of water) the Ether will repel it. When the Ether touches the Acid, the phenomena are reversed, and seem to observe the same dividing line in specific gravity as before. Similar conditions exist for Tartaric and Nitric Acids, when employing Ammonia, or Oil of Turpentine, etc., as the volatile liquids.

160. 1843. BRUECKE, E. Beiträge zur Lehre von der Diffusion tropfbar flüssiger Körper durch poröse Scheidewände. *Pogg. Ann.*, Vol. 58, p. 77-91.

The author points out that diffusion cannot consist merely of an exchange of fluids on both sides of the membrane, because concentrated solutions of Lead Acetate and Potassium Bichromate, when separated by a membrane, do not precipitate, even though diffusion be induced by dissolving sugar in either of these liquids.

The author also refutes the prevailing notion that strong chemical agents, as Sulfuric Acid, Nitrate of Silver or Nitric Acid destroy the action of animal membranes upon solutions.

161. 1843. ——— Report of a Commission regarding the effect of Oil on the Waves of the Sea. *Pogg. Ann.*, Vol. 60, p; 316.

The report of the committee on the subject ventilated by Van Beek (see No. 157,) is not favorable.

162. 1843. POISEUILLE. Recherches expérimentales sur le mouvement des liquides dans les tubes de très petits diamètres. *Ann. Chim. Phys.*, (3) Vol. 7, p. 50-74.

He established empirically the law that the quantity of effusion of liquids through capillary tubes is in inverse ratio to the length of the tube, and in direct ratio to the pressure, and to the fourth power of the diameter of the tube.

There is a minimum for the length of the tubes dependent solely upon their diameter, below which the law does not hold good. The experiments of Dubuat, (see No. 88a,) Gerstner, (see No. 51,) and Girard (see No. 87,) were carried on with tubes of insufficient length. There is no connection between capillary rise in tubes and the time of effusion, at least not for mixtures of Alcohol and Water.

163. 1843. BRUECKE, ERNST. Ueber das Bluten des Rebstockes. *Pogg. Ann.*, Vol. 63, p. 177-214.

In his treatise he discusses a very meritorious work on the motion of sap in plants, "*Vegetable staticks, or an account of some statical experiments on the sap in vegetables, etc.*, by Stephen Hales, London, 1727.

164. 1844. CHORON. Leidenfrost's Versuch auf Flüssigkeiten. *Pogg. Ann.*, Vol. 63, p. 352. See also *Comptes Rendus*, Vol. 19, p. 581.

Observed that Sulfuric Ether, when dropped upon Water, Mercury, Coal Oil, Nitric Acid, which are previously warmed to 54° C, showed the same behavior as when water is dropped upon red hot metallic surfaces.

165. 1844. BECQUEREL. *Traité de Physique*, Paris, 1844, Vol. 2, p. 243.

Studied the influence of temperature on the power necessary to separate adhesion plates from water. (See No. 178.) While the temperature varied from 12° to 78° C, the weight which was necessary to bring about separation, decreased by ¼ of its value, while the density of the water decreased only by 0.02. This supports the results obtained by Frankenheim and Sondhauss. (See No. 158.)

166. 1844. POGGENDORFF. On the Discovery of the phenomenon of Diffusion of Liquids. *Pogg. Ann.*, Vol. 63, p. 50.

NOLLET has first described that phenomenon in *Histoire de l'Acad. Roy. des Sciences*, Paris, 1748, (1752); the passage is quoted.

167. 1844. DRAPER, JOHN W. *A treatise on the forces which produce the Organization of plants.* New York. 1844.

The author recognizes capillary forces as the powerful agents instrumental in the building up of plants. He sees in the action of sunlight the ultimate cause of both the upward and downward motion of the sap in plants. This agency in decomposing carbonic acid gas on the upper surface of the leaves, creates a mucilaginous fluid, which is constantly displaced and forced downward by the thinner rising fluid, the latter having a greater attraction for the cell walls than is possessed by the mucilaginous fluid. On the same mechanical principle the motion of the blood in the capillaries and the function of the heart are also explained. The treatise further contains several of his memoirs on capillary attraction, (e. g. No. 186.) electricity and the chemical action of light.

168. 1845. BOUTIGNY. Recherches sur la formation de la vapeur. *Comptes Rendus*. Vol. 20. p. 614-616.

Determined the lower limits of temperature capable of producing the repulsion or spherical state for different liquids, as Water, Sulfuric Acid, Alcohol, Ether and various Oils. Discusses the important bearing which Leidenfrost's phenomenon has upon the safety of boilers.

169. 1845. BOUTIGNY. Extract d'un Mémoire contenant des expériences destinées à prouver que les corps à l'état sphéroidal réfléchissent presque complétement le calorique rayonnant. *Comptes Rendus*, Vol. 20, p. 885.

Demonstrates rather conclusively that the radiating heat emitted by the red hot vessel, does not enter the spheroidal liquid but is reflected from its surface. He also states that the temperature of the drop of water in the red hot vessel is 95° C. (See No. 141.)

170. 1845. DRAPER, JOHN. Is Capillary Attraction an electric Phenomenon? *Phil. Mag.*, (3) Vol. 26, p. 185. See also *Pogg. Ann.*, Vol. 67, p. 284, (1846).

The author supports his view of the electrical nature of capillarity by some additional experiments, (see No. 181,) for example: A drop of water upon a surface of Mercury that is connected with the negative pole of an electric battery, will spread over the Mercury as soon as the water is touched by the positive pole. Glass plates adhering to each other, possess free electricity after separation.

171. 1846. HAGEN, G. H. L. Ueber die Oberfläche von Flüssigkeifen. *Pogg. Ann.*, Vol. 67, p. 1-31, 152-172. From *Abh. Berl. Acad.*, (1845) p. 41-84. Also see *Ber. Berl. Acad.*, (1845) p. 166-169 and *Lieb. Ann.*, Vol. 60, p. 128-140.

The free surface of a liquid is in a state of tension, by virtue of which for example, the greatest velocity of a stream of water, does not occur in the surface, but at some distance below.

Hagen now evolves several formulas for the capillary surface of a liquid either touching one plate or rising between parallel plates or in capillary tubes, and tests the correctness of these formulæ by actual measurements. All these formulæ contain an expression for the surface tension of the liquid, which is defined as the weight necessary to tear asunder a liquid surface along the unit of length, and is determinable by experiment.

Hagen finally verified the value which he thus obtained for the surface tension by calculating it also from the weight of drops falling from a surface of known dimensions.

172. 1846. DONNY, F. Mémoire sur la cohésion des liquides, et sur leur adhérence aux corps solides. *Ann. Chim. Phys.*, (3) Vol. 16, p. 167. See also *Pogg. Ann.*, Vol. 67, p. 562-584 and *Lieb. Ann.*, Vol. 60, p. 141.

Liquids holding gases in solution, have hardly any cohesion. An aqueous column filling half of a closed glass tube 1 m long, may be torn for moments into 2 parts, by giving it a slight shock perpendicularly. But as the gases are expelled, the cohesion increases, until at their complete expulsion the cohesion is very powerful. Then it will be found impossible to tear asunder a column of water or sulfuric acid of 1m length, even if an almost complete vacuum is applied at its lower end. On these lines the author demonstrates also some interesting phenomena on the retardation of boiling, succeeding in raising the boiling point of water as high as 135° C. Hence if the process of boiling depends so much on the quantity of gas dissolved, it seems hardly proper to speak of a definite boiling point of a liquid.

173. 1847. BRUNNER, C. Untersuchung über die Cohäsion der Flüssigkeiten. *Pogg. Ann.*, Vol. 70, p. 481-529. Also see *Lieb. Ann.*, Vol. 64, p. 140.

He determined the height of rise of Water, Sulfuric Ether and Olive Oil in capillary tubes of known diameter at different temperatures, proving against Laplace and Poisson, that the heights decrease in a greater ratio than the specific gravities decrease. (See No. 158.) Especially is this evident for water which increases in specific gravity from 0° to 4°, while its capillary height steadily decreases. (See No. 175.) He established the following relation between temperature and height of rise in tubes of 1 mm. radius:

$$\left.\begin{array}{ll} \text{For Water,} & h= 15.83215 - 0.0286396t \\ \text{Sulfuric Ether,} & h= 5.3536 - 0.028012t \\ \text{Olive Oil,} & h= 7.4610 - 0.010486t \end{array}\right\} \text{where } t \text{ means degrees centigrade.}$$

174. 1847. MORITZ, A. Leidenfrost's Versuch auf Glas. *Pogg. Ann.*, Vol. 72, p. 112.

With reference to an experiment by Emsmann, (see No. 146,) the author finds that *boiling* water when placed upon a watch glass which is heated from below, will always exhibit the phenomenon, even if a large quantity of water is taken.

175. 1847. MORITZ, A. Ueber Coulomb's Verfahren, die Cohäsion einer Flüssigkeit zu bestimmen. *Pogg. Ann.*, Vol. 70, p. 74.

Employing the method of Coulomb (see No. 49,) the usefulness of which he emphasizes, he arrives at the conclusions,

1) That the adhesion of water attains a maximum at about 4° C. (Compare No. 173.)

2) That between 4° C and 34° C, the cohesion of water decreases more rapidly than the density.

176. 1847. BUYS-BALLOT. Ueber den Einfluss der Temperatur auf die Synaphie. *Pogg. Ann.*, Vol. 71, p. 177-194.

Determined the weights necessary to separate disks from the surface of different liquids, (Water, Copper Sulfate and Sodium Sulfate,) making the observations at different temperatures while these liquids were in the process of cooling.

177. 1847. HOLTZMANN, C. On the Cohesion of Water. *Pogg. Ann.*, Vol. 71, p. 563. See also *Lieb. Ann.*, Vol. 64, p. 147.

Confirms the formula obtained by Brunner for water (see No. 173,) arriving at almost the same values from an entirely different direction: Mechanical theory of heat.

178. 1847. FRANKENHEIM. Ueber die Abhängigkeit einiger Cohäsionserscheinungen flüssiger Körper von der Temperatur. *Pogg. Ann.*, Vol. 72, p. 171-229.

Tables are given which show the relation between temperature, specific gravity, and some constants of capillarity for Water, Oil of Turpentine, Lemon Oil, and several other organic and inorganic substances.

179. 1847. FRANKENHEIM. Ausdehnung einiger flüssiger Körper durch die Wärme. *Pogg. Ann.*, Vol. 72, p. 422-431.

The expansion by heat of the liquids spoken of in No. 178 is measured, and for each liquid the law of expansion is formulated.

180. 1847. POISEUILLE. Recherches expérimentales sur le mouvement des liquides de nature différente dans les tubes de trés-petits diamètres. *Ann. Chim. Phys.*, (3) Vol. 21, p. 76-110. See also *Lieb. Ann.*, Vol. 64, p. 129.

The former researches (see No. 162,) are here continued in order to ascertain, for physiological ends, whether an accelerating or a retarding influence is exerted on the flow of water or the serum of the blood through capillary tubes by the addition of weak solutions of acids, bases, salts, mineral waters and some pharmacal infusions.

181. 1848. LIEBIG, J. v. *Researches on the Motion of the Juices in the Animal Body, and the effect of evaporation in plants.* Translated from the German Edition of 1848 by Wm. G. Gregory, 1850, Philadelphia.

Giving an historical summary, and adding his own experiments on osmosis, the author leads us to regard the motion of the juices in the animal and vegetable bodies as being the consequence of cutaneous or surface evaporation.

182. 1848. PLATEAU, J. Ueber die Erscheinung bei einer freien und der Wirkung der Schwerkraft entzogenen Flüssigkeit. *Pogg. Ann.*, Erg. II, p. 249-285. From *Mém. Acad. Brux.*, Vol. 16.

Gives a complete review of his former experiments, with precautions necessary in order to succeed. (See No. 156.) Among other things he gives directions how to produce a Saturn like body, and sets forth an account of its formation.

183. 1848. HENRY. Beobachtungen über Capillarität. *Pogg. Ann.*, Erg. II, p. 358. From *Proc. Am. Phil. Soc.*, Vol. IV. p. 176.

When a silver plated piece of copper is heated above a certain temperature the silver disappears, apparently by evaporation, but the silver surface may b restored by dipping the metal into a solution of Chlorid of Zinc. This is evidently a capillary phenomenon.

184. 1848. KARSTEN, H. Das Bluten des Rebstocks unter den Tropen. (See No. 163.) *Pogg. Ann.*, Vol. 73, p. 19-40.

185. 1848. VIERORDT, K. Beschreibung eines verbesserten Endosmometers. *Pogg. Ann.*, Vol. 73, p. 529.

In this endosmometer the membrane is placed vertically, and precautions are also taken to maintain constancy of pressure on both sides of the membrane, as the reading of the volumes passed, would be rendered inaccurate by the bulging of the membrane under one sided pressure. The author by means of his apparatus verifies Dutrochet's result, that the rate of Osmosis of a solution is in direct proportion to its concentration.

186. 1848. FRANKENHEIM. Veränderung der Höhe des Quecksilbers in Capillarröhren mit der Temperatur. *Pogg. Ann.*, Vol. 75, p. 229-244.

Observations regarding the influence of temperature upon the height of a column of Mercury were made by means of a U tube, one arm of which was much wider than the other. Fairly constant results were obtained, only at temperatures above 100° C, i. e., rise of temperature then increased the difference of level. At ordinary temperatures the measurements gave very irregular results.

187. 1848. DANGER, T. P. Note sur la hauteur des ménisques que présente la surface du mercure contenu dans les vases en verre. *Ann. Chim. Phys.*, (3) Vol. 24, p. 501. See also *Pogg. Ann.*, Vol. 76, p. 297.

The author gives a table as the result of accurate observations wherein he records for each of 60 glass tubes varying in diameter from 1mm to 60mm, the total height of the mercurial meniscus in each tube, and the position of the intermediate level which would terminate a cylindrical meniscus of equal bulk. Hence this work gives us the data necessary to make accurate readings of mercurial heights in different tubes.

188. 1848. WILSON, GEORGE. On some Phenomena of Capillary attraction observed with Chloroform, Bisulfuret of Carbon, and other liquids. *Jour. Chem. Soc.*, 1849, p. 174-180.

He calls attention to the property of the common surface of Chloroform and water, which is rounded out by acids and flattened by alkalies.

189. 1848. SWAN, WILL. On certain Phenomena of Capillary attraction exhibited by Chloroform, the fixed Oils and other liquids. *Phil. Mag.*, (3) Vol. 33, p. 36-44.

Explains the phenomenon observed by Wilson (see No. 188.) by assuming a strong mutual surface attraction to exist between Chloroform and Caustic Potash, induced probably by their chemical affinity, and resulting in a strong horizontal force which is then modified by the action of the wall of the vessel.

190. 1849. FRANKENHEIM. Note zu meinen Versuchen über die Veränderung der Synaphie mit der Temperatur. Remarks to this by H. Buff. *Pogg. Ann.*, Vol. 77, p. 445 and Vol. 78, p. 578.

Controversy with regard to an alleged error in Frankenheim's calculations. (See No. 178.)

191. 1849. HAGEN, G. H. L. Ueber die Oberfläche von Flüssigkeiten. *Pogg. Ann.*, Vol. 77, p. 449-467. From *Abh. Berl. Acad.*, 1846, p. 1-16. Also see *Ber. Berl. Acad.*, 1846, p. 154-158.

Determined the surface tension (see No. 171.) of fresh and stale water, Gum and Lye water, also Olive Oil, Alcohol and Mercury, making use of three distinctly different methods, viz: Measuring the height of rise between parallel plates, determining the weights of drops formed at a surface of known dimensions and determining the weights necessary to separate adhesion plates from the liquids in question.

The surface tension of Mercury was found to be 0.0618 grms., this being seven times as much as that of clean water. It further resulted, that gum water has the same, but lye water a considerably lower surface tension than pure water, and that the surface tension decreases perceptibly for Water and for Mercury upon standing.

192. 1849. JOLLY, PH. Experimental-Untersuchungen über Endosmose. *Pogg. Ann.*, Vol. 78, p. 261-271.

Introduces the notion of Endosmotic Equivalents, these being the quantity of water exchanged for the passage in the opposite direction of a given amount of the dissolved substance. These equivalents he claims to be characteristic for each substance. (See No. 193.) The measurements were taken by weight, not by volume.

193. 1849. LUDWIG, C. Ueber die endosmotischen Aequivalente und die endosmotische Theorie. *Pogg. Ann.*, Vol. 78, p. 307-326.

He finds that each salt has its own specific equivalent, but this is not, as Jolly claims, (see No. 192,) a constant quantity for each substance, but depends on the degree of concentration of the solutions.

194. 1850. BRUNNER, C. Einfluss des Magnetismus auf die Cohäsion von Flüssigkeiten. *Pogg. Ann.*, Vol. 79, p. 141.

The discovery by Faraday of the influence of magnetism upon polarized light suggested to the author the possibility, that magnetism might also influence cohesion and especially effect capillary phenomena. But experiments carried out by MOUSSON with strong electro magnets and capillary tubes with water or a solution of an iron salt gave a negative result.

195. 1850. SCHNAUSS, J. Neue Versuche mit dem Leidenfrost'schen Phänomen. *Pogg. Ann.*, Vol. 79, p. 432.

Describes the phenomenon observed before by Laurent, (see No. 141,) viz., the formation of symmetrical figures. He likewise mentions the fact that the number of the protrusions is always even. Their number generally increases when the heat increases. He likens the phenomenon to the vibrations sometimes produced by sound.

196. 1850. GRAHAM. On the diffusion of liquids. *Phil. Trans.*, 1850, p. 1-45. Also see No. 198.

Numerous detail experiments, the first tnat were made systematically without the use of a membrane, lead to the following conclusions:

1)—Diffusion, like volatility, is a property of fundamental character, having even a larger scope.

2—A connection exists between diffusibilities and solution densities, relations between diffusibilities being apparent for equal weights, not for molecular weights.

3)—There is an analogy between isomorphism and diffusion, inasmuch as substances may be divided into classes of equidiffusive bodies; although they sometimes divide isomorphous groups.

197. 1850. GRAHAM, TH. Supplementary observations on the Diffusion of Liquids. *Phil. Trans.*, 1850, p. 805-836. Also see No. 198.

The main aim of this and the former paper (see No. 196,) was to supply accurate data regarding diffusibilities of as many soluble substances as possible. Close similarity, possibly equality exists in the diffusive power of certain classes of substances, e. g., the Chlorids and Nitrates of the same metal. The Hydrochlorates of Strychnine and Morphine are found to be equidiffusive.

198. 1850. GRAHAM, TH. Recherches sur la diffusion des liquides, *Ann. Chim. Phys.*, (3) Vol. 29, p. 197-229.

Résumé of Nos. 196 and 197.

199. 1851. GRAHAM, TH. On the diffusion of liquids. *Phil. Trans.*, 1851, II, p. 483-494.

This memoir treats of the diffusion of the Potassium and Sodium Salts only. In nine pairs of these salts the Potassium Salts diffused more rapidly than the corresponding Sodium Salts, and in the case of Rochelle Salt, even chemical decomposition took place, inasmuch as diffusion yielded three times more Tartrate of Potassium than of Sodium.

200. 1851. PLATEAU, J. Experimentelle und theoretische Untersuchungen über die Gleichgewichtsfiguren einer flüssigen Masse ohne Schwere. *Pogg. Ann.*, Vol. 82, p. 387-405. From *Ann. Chim. Phys.*, (3) Vol. 30, p. 203.

In continuance of his fundamental experiment (see No. 182,) the author produces additional figures of equilibrium of a liquid mass freed from the influence of gravitation, as cylinders, cubes and polyhedra, by introducing wire frames of proper form into this mass. As the shape of these figures may be calculated from the capillary theory, they form an excellent means to test the accuracy of the latter.

Finally speaks of the spontaneous conversion of a liquid cylinder into drops, and in connection therewith gives the theory of the form of a liquid jet issuing from a vessel, which subject had been experimentally investigated by SAVART.

201. 1851. PERSON, C. C. Ueber die Kraft, welche beim Leidenfrostschen Versuch den Tropfen trägt. *Pogg. Ann.*, Vol. 84, p. 274. See also *Comptes Rendus*, Vol. 31, p. 900 and Vol. 32, p. 463.

He holds that it is the tension of the vapors that supports the drop, and in order to prove it experimentally, he dips the upper end of a long S tube into the spheroidal liquid so as to touch the bottom of the red hot vessel. The other arm contains water which shows a difference of level equal to the height of the fluid in the red hot dish.

202. 1851. SIMON, DE METZ. Recherches sur la Capillarité. *Ann. Chim. Phys.*, (3) Vol. 32, p. 1-41.

Some results of his experiments are as follows: The law of rise in inverse ratio to the diameter, does not hold good for all diameters. The height to which a liquid rises between parallel planes, does not stand in the proportion of 1:2, compared with the rise in a capillary tube of a diameter equal to the distance between the plates. He claims the ration to be 1: 3.1416, the same as between diameter and circumference of a circle. Temperature remarkably influences the phenomena of rise in capillary tubes, as the same tube placed in water successively at 0° and at 100°, gives in both cases the ratio of 4:3.

203. 1852. TYNDALL, JOHN. On Molecular Action. *Brit. Assoc. Rep.*, 1852, (2) p. 20.

The author discovers the fact that the conductivity of wood for heat is not uniform in all directions, but is graded in magnitude along three axes rectangular to one another, whose location is determined by the structure of the wood. The same axes also indicate the gradations existing similarly for the forces of cohesion and of fluid permeability.

204. 1852. BEDE. Mémoire sur l'ascension de l'eau et la dépression du Mercure dans les tubes capillaires. *Bull. Acad. Belge*, (2) Vol. 19, p. 470.

He finds that Jurin's law (see No. 16,) agrees fairly well for mercury in tubes of less than 1mm. diameter, but as to the rise of water, he sustains Simon's results, (see No. 202,) finding that this fluid rises somewhat higher than the theory demands. He explains that discrepancy between Laplace's Theory and the experiment results from failure of the former to take into account the thickness of the liquid film, which is presumed to coat the inner walls of the tube, and to which the aqueous column adheres.

205. 1852. DESAINS, E. Anwendung der Theorie der Capillarphänomene. *Pogg. Ann.*. Vol. 86, p. 492. From *Comptes Rendus*, Vol. 34, p. 765.

Desains calculated the height of the meniscus for Mercury in tubes of different diameters by means of a formula given by Laplace, and the results were strikingly coincident with those obtained experimentally by Danger. (See No. 187.) He also calculated and verified experimentally the same values for the meniscus of water in glass tubes.

206. 1852. MUELLER. *Lehrbuch der Physik und Meteorologie.* 1853. Vol. I, p. 97-110. Capillarität.

207. 1853. SEGUIN, d. A. Theorie der Cohäsion und Trennung der materiellen Teilchen oder Molecüle der Körper. *Pogg. Ann.*, Vol. 88, p. 432. See also *Comptes Rendus*, Vol. 37, p. 704-709.

Considers the mass molecules consisting of rows of much smaller molecules each of which, although finite, is small beyond conception. Then the last atoms are as far distant from one another, as the celestial bodies are in space, and Newton's law is sufficient to express the attraction, that is, the cohesion, existing between them. (See No. 60.)

208. 1353. SEYFFER, O, Experimentelle physikalische Mitteilungen. *Pogg. Ann.*, Vol. 70, p. 570.

Describes a form of apparatus suitable to produce Plateau's phenomena (See No. 182.) Also discusses the observation made by Schnauss, regarding the symmetrical vibrations in Leidenfrost's experiment. (See No. 195.)

209. 1853. SIRE. Erscheinungen beim Auftröpfeln gewisser Flüssigkeiten auf die Oberfläche eines Aethers. *Pogg. Ann.*, Vol. 90, p. 626. From *Comptes Rendus.* Vol. 37, p. 667.

One drop of glacial Acetic Acid when placed upon ordinary SulfuricEther at 32° C, in a tube, 2—3 cms. wide, is seen to float, and swell to six times its bulk. Nitric Acid shows the phenomenon most strikingly, swelling to twelve times its bulk.

210. 1854. DUPREZ. Sur un cas particulier de l'équilibre des liquides. *Ann. Chim. Phys.*, (3) Vol. 42, p. 500.

The phenomenon of a large body of water being suspended from an inverted tumbler when a disk of paper is carefully placed against its rim, is in principle the same as that manifested in much narrower tubes where no paper need be used. In both cases the pressure of the air counteracts the weight of the aqueous column, but only under the condition that the free surface is one of stable capillary equilibrium. Such a condition being better insured in narrow tubes than in a wide glass, the use of a paper disk is necessary in the latter case, in order to prevent any deformation of the surface, especially at the edge of the glass, where the capillary equilibrium is most liable to be disturbed.

211. 1854. GRAHAM. On Osmotic Force. *Phil. Mag.*, (4) Vol. 8, p. 151. Also see *Phil. Trans.*, 1854, p. 177-228, and *Ann. Chim. Phys.*, (3) Vol. 45, p. 5-90.

Osmotic force is pronounced to be that peculiar power which causes the strong current of water to flow into different salt solutions separated from it by a membrane, as for example in Dutrochet's Endosmometer. Neither diffusion, still less capillarity is said to sufficiently explain the enormousness of that bulk of water exchanged for only minute amounts of salt. A number of interesting experiments tend to show that the phenomenon is mainly that of electro chemical action, whereby the membrane undergoes a gradual decomposition. The author finally points out the important function of the osmotic force in the plant and animal organisms.

212. 1855. BUNSEN, R. W. Ueber das Gesetz der Gasabsorption. *Lieb. Ann.*, Vol. 93, p. 116. See also *Phil. Mag.*, (4) Vol. 9, p. 116-130 and 181-201.

Theoretical considerations and experimental researches relative to the absorption of gases by water.

213. 1855. THOMSON, JAMES. On certain curious motions observable at the surfaces of wine and other alcoholic liquors. *Phil. Mag.*, (4) Vol. 10, p. 330-333.

The well known phenomenon commonly called the "tears of strong wine," is due to the same influence as that which causes a thin sheet of water to recede from a drop of Alcohol with which it is brought in contact. This results from the difference in surface tension between Water and Alcohol.

The author argues that the "tears" are produced by contact between the strong alcoholic liquid in the wine glass, and the fluid running down the sides, which has become more aqueous by evaporation. In support of this argument he adduces the fact that the "tears" do not form in corked vessels.

214. 1855. FICK, AD. Ueber Diffusion. *Pogg. Ann.*, Vol. 94, p. 59-86.

Fick was the first to formulate the data of diffusion into a law, which was later verified by H. F. Weber, viz:

The quantity of salt which diffuses in the unit of time between two elements of space filled with differently concentrated solutions of the same salt, is directly proportioned to the difference of concentration and inversely proportioned to the distance of the elements from one another.

215. 1855. BEER, A. Ueber die Oberfläche rotierender Flüssigkeiten, insbesondere über den Plateau'schen Rotationsversuch. *Pogg. Ann.*, Vol. 96, p. 1-18-210-254.

Establishing and discussing a mathematical expression for Rotationfigures as obtained in Plateau's experiment. (See No. 182.)

216. 1855. LHERMITE. Recherches sur l'endosmose. *Ann. Chim. Phys.*, (3) Vol. 43, p. 420-431.

Two liquids miscible with each other, (e. g., Alcohol and Water,) and separated by a thin stratum of a third, (e. g. Castor Oil,) that has affinity only for one of those, combine after some time, forcing the intermediate layer on top. This principle the author applies to the phenomenon of endosmosis. He also shows that water passes through a porous diaphragm into alcohol under ordinary conditions, but the reversed motion takes place when the diaphragm is previously saturated with Castor Oil.

217. 1856. RIJKE, P. L. Electricitätserregung, welche man beobachtet wenn eine Flüssigkeit den sphäroidalen Zustand verlässt. *Pogg. Ann.*, Vol. 98, p. 500.

Describes the conditions under which electrical phenomena exhibited in Leidenfrost's experiment, are most pronounced. The liquids used were Water, Acids, Alkalies and Salts.

218. 1856. WOLF, C. Ueber die Temperatur, bei der die Flüssigkeiten die sie einschliessenden Gefässe zu benetzen aufhören. *Pogg. Ann.*, Vol. 98, p. 643. See also *Comptes Rendus*, Vol. 42, p. 968.

Brunner's formula (see No. 178,) indicates that for Sulfuric Ether the capillary height would be 0 at a temperature of 191° C. Wolf now observed, that upon heating a sealed glass tube enclosing a capillary tube and some Ether, the capillary height gradually diminished and became 0 at about 190-191° C. The curvature of the meniscus became more and more flat, and at the aforenamed temperature level. Upon further heating he observed even depression of the Ether column and a convex curvature of the meniscus. At 200° C the whole liquid became converted into vapor. (See No. 96.) Upon cooling, the same phenomena took place in reversed order. (Compare DRION, No. 239.)

219. 1856. JAMIN, J. Ueber die Endosmose der Gase. *Pogg. Ann.*. Vol. 99, p. 327-329. From *Comptes Rendus*, Vol. 43, p. 234.

Repeating Magnus' Experiments (see No. 105,) he makes use of a porous cell to which he gives a thin coating of collodium. By connecting the closed cell with a water reservoir by means of a long glass tube, and filling the cell with Hydrogen gas, the process of diffusion will cause the water to rise in the tube as high as 2-2½ meters in 20 seconds.

220. 1856. SCHMIDT, WILLIBALD. Versuche über Filtrationsgeschwindigkeit verschiedener Flüssigkeiten durch tierische Membran. *Pogg. Ann.*, Vol. 99, p. 337-388.

Studied the influence of pressure and of temperature upon the velocity of filtration of different liquids through animal membranes.

221. 1857. DESAINS, E. Recherches sur les phénomènes capillaires. *Pogg. Ann.*, Vol. 100, p. 356. From *Ann. Chim. Phys.*, (3) Vol. 51, p. 385-445.

Desains, endeavoring to verify Laplace's theory, (see No. 64,) determined the dimensions of a drop of Mercury on glass, the height to which water rose in glass tubes and between glass plates, and found a close coincidence between theory and experiment. However Hagen's suggestion (see No. 171,) to consider the meniscus in capillary tubes as a hemi-ellipsoid, is found to approach the experimental results better than Laplace's assumption of a hemispherical meniscus.

222. 1857. BEER, A. Ueber die Plateau'schen Versuche mit Flüssigkeiten, welche der Wirkung der Schwerkraft entzogen sind. *Pogg. Ann.*, Vol. 100, p. 458.

Discusses from a mathematical point of view, the changes that may take place in the form of a liquid cylinder or of a globe, rotating around an axis.

223. 1857. SIMMLER, TH. and WILD, H. Neue Methode zur Bestimmung der bei der Diffusion einer Salzlösung in reine Lösungsmittel auftretenden Constanten. *Pogg. Ann.*, Vol. 100, p. 217 and 660.

Mathematical deductions for which data were obtained by placing the salt solution against a water column in suitable vessels, and determining the change in concentration both by gravimetric analysis and by optical methods. (See No. 294.)

224. 1857. WOLF, C. Einfluss der Temperatur auf die Erscheinungen in Haarröhren. *Pogg. Ann.*, Vol. 101, p. 550-576 (A) and Vol. 102, p. 571 (B). See also *Ann. Chim. Phys.*, (3) Vol. 49, p. 230-281.

A)—Gives an historical résumé of previous investigations regarding the relations between Temperature and Capillarity.

B)—His experiments corroborate Brunner's conclusions that the decrease of capillary height with temperature is more rapid than that of density, (see No. 178,) which fact contradicts some phases in Laplace's theory. (See No. 64.) The interesting behavior exhibited by Ether in a capillary tube, at high temperature in closed vessels, (see No. 218,) leads him to view the phenomenon of rise and depression, as the result of a general law of continuity.

225. 1857. POGGENDORFF. Note on earliest history of Capillarity. *Pogg. Ann.*, Vol. 101, p. 551. See No. **1.**

226. 1857. PLATEAU, J. Transformation des flüssigen Cylinders. *Pogg. Ann.*, Vol. 102, p. 320.

Plateau calls attention to the fact that some of Beer's former theoretical deductions (see No. 222,) were not borne out by experiment.

227. 1857. WERTHEIM, G. Ueber die Capillarität. *Pogg. Ann.*, Vol. 102, p. 595. See also *Comptes Rendus*, Vol. 44, p. 1024.

In order to test Laplace's theory experimentally, he measured the *bulk* of liquid which rose spontaneously under various conditions. He observed, for example, that with the same liquid a constant bulk rises between two parallel plates, irrespective of the distance between the plates.

228. 1857. WILLIGEN, VAN DER. Ueber die Constitution der Seifenblasen. *Pogg. Ann.*, Vol, 102, p. 629.

Observed in soap bubbles a distinct line of demarcation between the black zone on top of the bubble and the zone of colors below. He concludes that a soap bubble consists of an interior aqueous non-refractive layer, which supports a layer of fatty substance, the latter agent being the refractive medium, that gives rise to the colors. Striving to sink to the lower part of the bubble, it leaves the aqueous black skin on top and forms a distinct boundary zone.

229. 1857. VALSON, ALPH. Sur la théorie des phénomènes capillaires. *Comptes Rendus*, Vol. 45, p. 10.

Verifies BERTRAND'S observation (*Journal de Liouville*, June, 1848,) that the total mass of a cylindrical column elevated by capillarity, is the same as when bubbles of air are interposed. He further considers various phases of capillary phenomena, for example, the time required for a liquid capillary column to assume its state of equilibrium. (Compare No. 330.)

230. 1857. VALSON, ALPH. Application de la théorie de l'action capillaire à la recherche des variations des actions moléculaires dans les liquides. *Comptes Rendus*, Vol. 45, p. 101.

Observed the fact that in making mixtures of miscible liquids, and changing the proportions of the constituents, these variations are strikingly indicated by corresponding variations in the capillary rise of the resultant liquids. This being especially the case for mixtures of Alcohol and Water, the construction of a sensitive Alcoholometer on this principle is suggested. (See No. 56.)

231. 1857. DESAINS, E. Ueber das capillare Aufsteigen des Wassers zwischen parallelen Platten. *Pogg. Ann.*, Vol. 102, p. 601. See also *Comptes Rendus*, Vol. 45, p. 265.

Denying the correctness of Simon's statement, (see No. 202,) also upheld by Wertheim, (see No. 227,) that water rises between parallel plates about ½ as high as in a capillary tube whose diameter is equal to the distance of the plates, he brings additional experiments to prove that the proportion is exactly 1:2.

232. 1857. GILBERT. Ueber die Theorie der Capillarphänomene. *Pogg. Ann.*, Vol. 102, p. 605. See also *Comptes Rendus*, Vol. 45, p. 771.

From a formula given by Gauss, (see No. 115,) he deduces the proportion of 1 : 3.1416/2 for the height to which water rises between two parallel plates and in capillary tubes of a diameter equal to their distance. (Compare Nos, 202 and 231.)

233. 1858. DUBOIS-REYMOND P. Ueber die Erscheinungen, welche die Ausbreitung von Flüssigkeiten auf Flüssigkeiten hervorruft. *Pogg. Ann.*, Vol. 104, p. 193-234.

The case of Alcohol expanding on Oil and that of Oil expanding on water, are types of different modes of expansion. The former is stationary, that is, it extends only over a limited area, leaving a nucleus of Alcohol of a certain thickness in its center. The second is unlimited, the oil spreads rapidly until the central drop is dissipated over the aqueous surface, then if a sufficient amount of oil is employed, the film contracts into a number of oily drops. These conditions in connection with the Newton's rings observable in these phenomena, are here investigated.

234. 1858. QUINCKE, G. Ueber die Capillaritätsconstanten des Quecksilbers. *Pogg. Ann.*, Vol. 105, p. 1-48.

Quincke, seeking to corroborate Laplace's and Young's capillary theories, (see Nos. 63 and 64,) which emphasize the constancy of angle of contact between liquid and solid, attempted to determine the angle of contact between mercury and glass. But both indirect and direct measurements, (the latter on the principle of triple reflection of light,) proved that the angle of contact of mercury for glass is very inconstant, probably owing to changes in the condition of both mercury and glass. The angle varied from 38° to 42°54'. in one series of determinations.

235. 1858. QUINCKE, G. Ueber die Verdichtung von Gasen und Dämpfen an der Oberfläche von Flüssigkeiten. *Pogg. Ann.*, Vol. 105, p. 326-353.

Gives an interesting review of former experiments by SAUSSURE, MOSER, WAIDELE, KARSTEN and others, illustrating the property of solid bodies to absorb gases on their surfaces, and their behavior towards heat, light and electricity. He comes to the conclusion that the absorption is in proportion to the density and the surface of the solid body, provided the same law of attraction holds good on both the surface and the inside of the solid.

236. 1858. BEDE. Recherches sur la capillarité. *Bull. Acad. Belge*, (2) Vol. 16, p. 405-411.

Measured the depression of Mercury in glass tubes by means of an electrical arrangement, but made the readings only after prolonged standing, which is now known to affect the surface tension of Mercury very materially. He also experimented on the depression of melted lead and tin in capillary spaces. (See No. 26.)

237. 1859. SORBY. On the freezing point of water in capillary tubes. *Phil. Mag.*, (4) Vol. 18, p. 105.

The investigation was suggested by the behavior of fluid enclosures in quartz. In tubes of 1-4 to 1-40 inch in diameter, water did not freeze at—5° C, but froze at—6° C. In tubes of 1-100 inch, water did not freeze at—11° C, but froze at—18° C. Between 1-200 and 1-800 inch, water did not freeze at—15°, even when the tube was shaken, but froze at—17°, when the tube was kept perfectly quiet.

238. 1859. LANGBERG, CH. On the influence of capillary attraction upon the Hydrometrical measurement of the specific gravity of liquids. *Phil. Mag.*, (4) Vol. 18, p. 113, From *Pogg. Ann.*, Vol. 106, p. 299.

The author observed differences of ½ to 1% in the indications of Alcoholometers, according to whether they were tested by means of fluids of known strength, or by BRISSON'S method, (i. e., calculating the specific gravity of alcohol from the weight required to sink the instrument in water to the same mark to which it sank in the alcohol to be examined.) He concludes that the capillary fluid wall which adheres to the stem, increases the weight of the apparatus, thereby causing a false indication. Calculates the magnitude of this influence and finds the values closely approach the discrepancy before cited, (See No. 78.)

239. 1859. DRION, CH. Expériences relatives à l'influence de la chaleur dans les phénomènes capillaires. *Ann. Chim. Phys.*, (3) Vol. 58. p. 221.

Operating on Sulfuric Acid, Ethyl Chlorid and Sulfuric Ether, the author confirms in part only Wolf's observations. (See No. 218.) He finds that the curvature of the liquid decreases with rising temperature, but becomes a plane only at the moment of vaporization. He observed a depression of the inner liquid below the outside surface but not a convex meniscus. Hence he ascribes this depression to a sudden manifestation of the dilatability which the outer liquid possesses to a considerable degree near its point of volatilization.

240. 1859. PLATEAU, J. Title as in No. 183. 4th series. *Pogg. Ann.*, Vol. 107, p. 394-409.

Continuation of the studies of Rotation figures. By the rotation of solid bodies of definite shapes in Oil, he produces three new classes of figures which he calls UNDULOIDS, CATENOIDS and NODOIDS.

241. 1860. WRIGHT, T. ST. On the behavior of Mercury as an electrode. *Phil. Mag.*, (4) Vol. 19, p. 129.

Results: 1) So soon as chemical affinities are excited in the galvanic processes there takes place at the same time an increased intensity of the attraction of surfaces (that is, of capillary attraction.) 2) The connexion which has been supposed to exist between capillary or surface attraction and chemical affinity, receives from this a notable confirmation.

242. 1860. JAMIN, J. On the Equilibrium and Motion of Liquids in porous bodies. *Phil. Mag.*, (4) Vol. 19, p. 204. From *Comptes Rendus*, Vol. 50, p. 172, 311, 385.

When a capillary tube contains a great number of air bubbles, it can sustain a very high column of water, the height of which is dependent upon the number of the bubbles. This in connection with surface evaporation will sufficiently explain the rise of sap in plants. (See Nos. 105 and 168.)

243. 1860. BEDE. Recherches sur la capillarité. *Bull. Acad. Belg.*, (2) Vol. 10, p. 47-55.

Repeated experiments show that the product of the radius of the capillary tube into the height of the column increased by ⅓ of the radius, is about constant for diameters from 2 mm. down to 0.1 mm. (See No. 204.) Also retraces his former theory regarding the influence of the adhering film.

244. 1860. MENDELEEFF. Sur la cohésion moléculaire de quelques liquides organiques. *Comptes Rendus*, Vol. 50, p. 52.

Algebraically combining molecular weight with an expression for cohesion, he finds for a series of organic substances like Alcohols, Acids and Ethers certain regularities for this MOLECULAR COHESION, as he calls it. For example, the molecular cohesion of homologous bodies increases by a fairly constant number with the molecular weight. Isomeric bodies possess equal molecular cohesion.

245. 1860. MENDELEEFF, D. Sur la cohésion de quelques liquides et sur le rôle de la cohésion moléculaire dans les réactions chimiques des corps. *Comptes Rendus*, Vol. 51, p. 97.

Continuing his former researches, (see No, 244,) he finds the increase in molecular cohesion to vary from 50 to 90 for each CH_2 of an homologous series. He attributes to molecular cohesion a dominating influence upon chemical reactions, inasmuch as he claims a tendency to exist towards forming substances of highest molecular cohesion.

246. 1860. HAGENBACH. Ueber die Bestimmung der Zähigkeit einer Flüssigkeit durch den Ausfluss aus Röhren. *Pogg. Ann.*, Vol. 109, p. 385-426.

Defining "viscosity" as the force necessary to move a fluid layer of the thickness of a molecule and of the unit of surface in one second with uniform velocity along an adjoining layer for a distance of 2 molecules, he finds the viscosity of Water at 10° C=0.18851 grams, using a meter square as the unit of surface. Viscosity decreases considerably with rising temperature. Through purely mathematical reasonings he arrives at exactly the same formula which Poiseuille had found experimentally for the flow of a liquid through capillary tubes. (See No. 162.)

247. 1860. SCHUMACHER, W. Ueber Membrandiffusion. *Pogg. Ann.*, Vol. 110, p. 337-370.

Experiments on the diffusion of Acids and Salts into water, by making use of tubular membranes of Collodium and taking the precaution of maintaining equal pressure on both sides of the membrane. The author corroborates Ludwig's results (see No. 198,) to the effect that the notion of definite Endosmotic Equivalents cannot be upheld. With Oxalic Acid the "endosmotic equivalent" is very considerable in very dilute solution. The reverse is the case with Sodium Chlorid. Rise in temperature speeds the osmotic action.

248. 1860. BOUTIGNY. Sur l'état sphéroidal de la matière. *Comptes Rendus*, Vol. 50, p. 675.

The spheroidal state of matter is not confined to liquids alone, for solid bodies, like Ammonium Chlorid, Tallow, Corrosive Sublimate, Camphor, Iodine, etc., may also exhibit that phenomenon. The author calls especial attention to the fact that small pieces of ice placed upon the back of the hand, produce in quick succession two distinctly different sensations, first that of heat, 98° C, and then of cold, 0° C. Both temperatures are observable by means of the thermometer, when using larger quantities of ice.

249. 1861. TATE, T. On certain peculiar forms of capillary action. *Phil. Mag.*, (4) Vol. 21, p. 254-257.

Demonstrates the capillary action of small openings in the walls of cylindrical glass vessels which hold a column of water suspended above a water surface. The height which can thus be supported notwithstanding the opening, is equal to the height to which water would rise in a capillary tube of the same diameter as that of the hole. (Compare No. 16.)

250. 1861. WERTHEIM, G. Mémoire sur la Capillarité. *Ann. Chim. Phys.*, (3) Vol. 63, p. 129-193. (Submitted to the Acad., 1854.)

He compares the capillary action of liquids on plates and the outside surface of cylinders. The aim is to find in each case the relations existing between the nature of the solid and the liquid on one hand, and the volume of liquid which is raised or depressed and the form of its surface and its contour on the other. He largely employs melted wax which after solidification affords a convenient means of measuring the quantities in question. (See No. 227.)

251. 1861. MENDELEEFF. Ueber die Ausdehnung der Flüssigkeiten beim Erwärmen über ihren Siedepunkt. *Lieb. Ann.*, Vol. 119, p. 1.

For Ether, Alcohol and Water, also for Benzine and Silicon Chlorid, he observed that these liquids, when heated in closed glass tubes above their boiling point, follow the same laws of expansion that hold good for temperatures below their boiling point. The latter have been empirically established by KOPP.

252. 1861. DESAINS, E. Lettre sur une expérience de M. Wertheim sur la Capillarité. *Ann. Chim. Phys.*, (3) Vol. 63, p. 447-458.

Reports the result of an experiment made by Mr. Wertheim upon Desain's suggestion. Accordingly the height of rise of water between glass plates agrees closely with the value calculated from Laplace's theory, which tends to disprove Simon's conclusion. (See Nos. 202 and 227.)

253. 1861. GRAHAM, TH. Liquid diffusion applied to Analysis. *Phil. Trans.*, 1867 p. 183-224. Also see *Phil. Mag.*, (4) Vol. 23, p. 204-223, 290-306, 368-379, (1862.)

In this famous treatise the author expounds the principle of Dialysis. Establishes the distinction between Crystalloids and Colloids, based on the marked difference in their diffusibilities into water, which affords a means of separating both classes of substances. (Dialysis.)

The author shows that crystalloids will not only dialyze into water, but also into colloids, like Jelly, etc., while Caramel for example, refuses to pass into this medium. Gives minute directions how to prepare inorganic soluble colloid substances, like soluble Silicic Acid, Alumina, Peroxide of Iron, Prussian Blue, etc., and also how to prepare organic colloids by Dialysis, like Tannin, Gum, Dextrin, etc.

254. 1861. GRAHAM, TH. On liquid transpiration in relation to chemical Composition. *Phil. Trans.*, 1861, p. 373-386. See *Phil. Mag.*, (4) Vol. 26, p. 409-434.

Defining Transpiration as the passage of liquids under pressure through a capillary tube, he confirms the observation made by Poiseuille, (see No. 162,) that a definite hydrate of alcohol, corresponding to the (modern) formula of $C_2H_6O.3H_2O$, requires more time for transpiration under constant pressure than if either water or alcohol is added to it. Graham furthermore finds that the same phenomenon, that is, a maximum of retardation, takes place in the transpiration of certain mineral and organic acids at those points where the composition corresponds to definite hydrates of the acids.

255. 1861. TOMLINSON, CH. On the action of certain vapors on films. On the motion of Creosote, Benzoic Acid, Camphor, etc., on Water. *Phil. Mag.*, (4) Vol, 22, p. 111-120. See also *Phil. Mag.*, (4) Vol. 27, p, 528-539, (1864.) *Chem. News*, Vol. 8, p. 28, 37 and 123, (1863.) *Chem. News*, Vol. 10, p. 25, (1864.)

Numerous experiments similar in principle to those instituted by previous workers. (See Nos. 52, 54, 57 and 233.)

256. 1861. TOMLINSON, CHARLES, On the Cohesion figures of liquids. *Brit. Assoc. Rep.*, 1861, (2) p. 93, Also see *Phil. Mag.*, (4) Vol. 22, p. 249-261. *Phil. Mag.*, (4) Vol. 23, p. 186-195, (1862.) *Pharm. Journal*, (1864) p. 387 and 495.

When a drop of an independent liquid, (that is, not a solution, e. g. oil of lavender,) is placed upon another, e. g. Water, a struggle takes place between them, giving rise to beautiful figures, which the author calls cohesion figures.

He thinks some of these figures are characteristic of the substances producing them, and suggests the applicability of this phenomenon for the detection of adulteration in oils. Olive Oil, for example, may be recognized in Oil of Cloves by the beautiful iridescence which it imparts to cohesion figures on water.

257. 1861. LEROY, M. L. Testing pharmaceutical preparations by means of blotting paper. *Amer. Journ. Pharmacy*, Vol. 33, p. 93.

Editorial comment upon this suggestion. (See No. 259.)

258. 1861. ECKHARDT. Ueber die Depression des Quecksilbers im Barometer. *Pogg. Ann.*, Vol. 112, p. 336.

The depression of the Mercury in barometric tubes depends conjointly on the width of the tube, and the radius of curvature of the meniscus. In a siphon barometer the depression of Mercury is equalized only, if the meniscuses in both arms of the barometer have also the same radius of curvature.

The author gives a formula by means of which the correct height can be calculated if diameter and height of meniscus are known.

259. 1861. SCHOENBEIN, C. F. Ueber einige durch die Haarröhrchenanziehung des Papiers hervorgebrachte Trennungswirkungen. *Pogg. Ann.*, Vol. 114, p. 275.

He demonstrates the differentiating influence which paper exerts upon solutions of various kinds, e. g., Alkalies, Acids, Salts and certain vegetable dye stuffs. In almost every case water travels much faster than the substance held in solution by it. (See No. 271.)

260. 1861. PLATEAU, J. Title as in No. 182. 5th series. *Pogg. Ann.*, Vol. 114, p. 597-608.

His study of thin liquid films, e. g., soap bubbles, demonstrates the pressure which the film surface exerts upon the air enclosed. Calculates that the upper limit of the radius of the sphere of molecular action is 1-17000 mm.

261. 1862. GUINET, ERNEST. Phenomena of Transport through porous bodies. Application to direct Analysis. Dialysis. *Comptes Rendus*, 1862. See also *Phil. Mag.*, (4) Vol. 25, p. 80, (1863.)

With regard to Graham's researches on Dialysis, the author suggests to substitute for the parchment membrane a porous vessel of pipe-clay. This medium allows the dialyzing of solutions which would destroy parchment. e. g., solution of Cellulose in ammoniated Copper Salts.

He explains the phenomena of dialysis by presuming the porous medium to act as a sieve, which excludes substances of high molecular volume (as Colloids) and, with regard to crystalloids, allows more ready passage to those with smaller molecular volume, (Sulfur passes more readily than Iodine, when both are employed in CS_2 Solution.)

262. 1862. BEDE, EMILE. Recherches sur la liaison entre les phénomènes de Capillarité et d'Endosmose. *Bull. Acad. Belg.*, (2) Vol. 13, p. 111.

Water, by evaporating from the surface of an animal membrane (see experiment by Magnus. No. 105,) produces a suction of 79 mm. Mercury in 23 days. Alcohol, Ether, and Oil of Turpentine have little or no such action. Salt solutions, if concentrated, produce less suction than dilute solutions; thus concentrated solutions penetrate animal membranes with more difficulty than dilute solutions. Endosmosis is pronounced to be the result of the different tendencies which are inherent in the fluids existing at both sides of the membrane to penetrate the latter; such tendency being measurable by a column of mercury elevated by suction, as illustrated in the experiment of MAGNUS.

263. 1862. BEDE, E. Recherches sur la Capillarité. *Bull. Acad. Belg.*, (2) Vol. 14, p. 344-349.

Seeks to verify by experiment some theoretical conclusions regarding the height of wide bubbles of air under horizontal glass plates within liquids of various nature, likewise the equilibrium of drops of various liquids between glass plates which form an angle with each other. In the former case, Water and Ammonia present the exceptional phenomenon of causing a maximum and afterwards a minimum height of the air bubble.

264. 1862. WIENER, CHR. Erklärung des atomistischen Wesens des tropfbar-flüssigen Körperzustandes, und Bestätigung desselben durch die sogenannten Molecularbewegungen. *Pogg. Ann.*, Vol. 118, p. 79-93.

The hypothesis is advanced that all substances consist of atoms of matter, attracting one another. Interspersed with ether atoms, repelling one another and being repelled by the atoms of matter. These two kinds of atoms forming two different systems of vibrations; in solid bodies both systems are supposed to perform opposite oscillations, in liquid bodies, oscillations in the same direction. When solids are being melted, it is the function of the latent heat to change the direction of the oscillation. The author seeks to demonstrate by means of the microscope the molecular motions existing in liquids.

265. 1862. PLATEAU, FELIX. Sur un mode particulier de produire les bulles de savon. *Bull. Acad. Belg.*, (2) Vol. 13, p. 286. See also *Pogg. Ann.*, Vol. 121, p. 653, (1864.)

When throwing a sheet of soap water into the air under an angle of about 45 degrees, it resolved itself into soap bubbles of different sizes, from 8 to 9 centimeters downwards. He presumes that clouds originate on this principle.

266. 1863. MEUNIER. On the globular form that liquids may assume on surfaces of their own kind. *Comptes Rendus*, Vol. 57, p. 401.

It is demonstrated that under certain precautions all liquids, even water can be made to form globules of their own kind on their surfaces.

267. 1863. DUPREZ, F. Note sur la cause qui s'oppose à l'introduction d'un liquide dans un vase à orifice étroit. *Bull. Acad. Belg.*, (2) Vol. 16, p. 11.

A vessel having a very narrow neck or admission tube, cannot well be filled with a liquid, not so much because the air is opposing admission, but on account of the resistance of the capillary surface of the liquid. For the admission tube, a maximum diameter exists below which no fluid can enter the vessel. This diameter closely depends on the cohesion, (capillarity) not the viscosity of the fluid. Thus a very viscous liquid but of small cohesion, like Bitter Almond Oil, may pass a tube, which another much thinner liquid of great cohesion, like Water, cannot pass, because the latter forms a larger surface of capillary equilibrium. Beyond the maximum diameter, the capillary equilibrium of the fluid becomes unstable, and the liquid enters the vessel.

268. 1863. TOMLINSON, CH. *Experimental Essays.* London, 1863.

The following special point may be mentioned here: p. 47, he states that creosote is slightly heavier than water; (sp. g.=1.056;) but by carefully delivering a drop to the surface of water from the end of a glass rod, it will not sink; but the under surface of the drop will be convex below the general surface of the water.

269. 1863. GRAHAM. On the molecular Mobility of Gases. *Phil. Trans.*, (1863) p. 385-405. See also *Ann. Chim. Phys.*, (4) Vol. 2, p. 107-142, (1864.)

Various gases were aspirated through membranes of artificial graphite and other materials into a partial vacuum in which was maintained a constant degree of vacuity. Then it was found that the lighter gas passed through the porous membrane more readily than the heavier gas. The penetration points for several gases were found to be in the ratio of the square roots of their densities. (Compare No. 180.) This behavior of gases suggests to the author the possibility of separating mixtures of gases by aspirating them through porous membranes. (Atmolysis.)

270. 1863. PROCTOR, B. S. Graduated Measures. *Amer. Jour. Pharm.*, Vol. 35, p. 247. From *Chemist and Druggist*, 1863.

Points out some sources of error in reading graduated measures, the chief source being the discrepancy between readings made from the general surface of the fluid or its capillary edge. The former method is preferable.

271. 1863. GOPPELSROEDER. On a new method for determining the Nature of a Mixture of Coloring principles. *Amer. Journ. Pharm.*, Vol. 35, p. 178. See also *Pogg. Ann.*, Vol. 115, p. 487-494, (1862.)

Studies the capillary action of filtering paper on solutions, as observed before by Schoenbein. (See No. 259.) The author discovers the property of Picric Acid to be conspicuous among many solutions in its power to rise in filtering paper. This behavior of Picric Acid permitted the author to establish with certainty its presence in commercial fuchsin obtained from coal tar.

272. 1863. MUSCULUS. Des Phénomènes capillaires appliquée à la détermination de la richesse alcoolique des vins et de la force de l'acide acétique. *Mém. Méd. Milit.*, Vol. X, p. 465-475 and Vol. XIII, p. 74-80. See also *Chem. Centralblatt*, Vol. 9, p. 922-925, (1864.)

The author points out the marked influence which small amounts of Alcohol (one per cent. and less) or Acetic acid have on the capillarity of water, and suggests the use of his capillarimeter, which for example indicates the presence of 1-40 per cent. of alcohol, where the regular methods of analysis fail. Extractive matters, as sugar, salts, have much less influence upon the capillarity of water than Alcohol or Acetic Acid.

273. 1863. WILHELMY, L. Ueber die Abhängigkeit der Capillaritäts-Constanten des Alcohols von Substanz und Gestalt des benetzten festen Körpers. *Pogg. Ann.*, Vol. 119, p. 177-217.

The constant of capillarity herein considered being pronounced to be the weight of liquid which a solid can carry along the unit of length of the latter, the author introduced a novel method for determining this constant, by direct weighing. He observes, however, that the number is not constant but variable, depending both on the nature of the solid, and especially becoming less the more curved the solid is. (See Wertheim, No. 250.) Besides, his results lead him to presume that a condensation of liquid takes place on the surface of the solid. (See Poisson, No. 118.) Subsequent workers have taken issue with these statements.

274. 1863. BERGER. Ueber den Sphäroidalzustand. *Pogg. Ann.*, Vol. 119, p. 594-697.

The main phases of Leidenfrost's Phenomenon (see No. 28,) are critically reviewed and original experiments added.

275. 1864. MENSBRUGGHE, VAN DER. Sur quelques effets curieux des forces moléculaires des liquides. *Bull. Acad. Brux.*, Vol. 18, p. 161-168. See also *Phil. Mag.*, (4) Vol. 18, p. 434-8. *Pogg. Ann.*, Vol. 127, p. 97-105, (1866.)

He describes the formation of liquid bubbles by a certain peculiar manipulation, similar to that recorded by F. Plateau. (See No. 265.) This phenomenon has a bearing on the theory of the formation of fog. Furthermore he describes some capillary experiments with globules of Mercury floating upon water.

276. 1864. GUTHRIE, FRED. On Drops. *Proc. Roy. Soc.*, Vol. XIII, p. 444-483, (1864) and Vol. XIV, p. 22-33, (1865.) See also *Pogg. Ann.*, Vol. 131, p. 128. *Fortschr. d. Physik*, 1865, p. 99, and *Chem. News*, Vol. 10, p. 270.

The author determines the weight of drops of various liquids, (Cocoanut Oil, Salt Solutions, Water, Mercury, etc.,) when forming under various conditions, e. g., forming in air, or surrounded by other liquids and mixtures of liquids, and either falling or rising in the latter, according to the specific gravities. The author thinks a chemical diagnosis possible by a closer study of the magnitude of drops and bubbles.

277. 1864. BARBIER, E. Application des phénomènes Capillaires à la construction de divers thermométrographes. *Ann. Chim. Phys.*, (4) Vol. 2, p. 67.

Devises an instrument similar to Rutherford's Thermometrograph, but which allows the reading of both maximum and minimum temperatures by means of two indexes which are being dislocated by the variations in temperature through the capillary action of an air bubble within the instrument.

278. 1864. MAGNUS, G. Ueber die Verdichtung von Dämpfen an der Oberfläche fester Körper. *Pogg. Ann.*, Vol. 121, p. 174-185.

Condensation of Vapors of any kind on the surfaces of solid bodies takes place with such an intensity, that the phenomenon is accompanied by distinct changes in temperature. Hence there exists at any time on the surface of a solid body a stratum of condensed vapors which varies in thickness according to the humidity of the atmosphere.

279. 1864. WILHELMY, L. Ueber die Abhängigkeit des Capillaritäts-Coeffizienten der Flüssigkeiten von ihrer Zusammensetzung. *Pogg. Ann.*, Vol. 121, p. 44-63.

The method of the author to determine the coefficient of capillarity is to weigh the capillary wall which is formed against a solid plate dipped into the fluid. This method is extended to various organic liquids. As a result, certain axioms are pronounced, bearing on the dependency of the coefficient of capillarity on atomic variations.

For example:—Addition of the carbon atom increases, while that of the Hydrogen atom decreases the coefficient of capillarity. The members of an homologous series (whose difference is Cn H 2 n) have about the same Coefficient of Capillarity.

280. 1864. WILHELMY, L. Ueber die Abhängigkeit des Capillaritäts-Coeffizienten der Flüssigkeiten von der chemischen Beschaffenheit und Gestalt der festen Wand. *Pogg. Ann.*, Vol. 122, p. 1-17.

The result of the author's work on Amylalcohol, Glycerin and other organic liquids along the lines pursued in No. 278, is here summarized in several tables, which demonstrate some seemingly regular variations in the coefficients of capillarity for these liquids when in contact with solids of different material and different curvature. Part of these results suggest the theory that a solid when immersed in a fluid, will condense a certain quantity of the fluid on its surface. Glycerin, however, presents a striking exception, if a plate is dipped into it and tared, it becomes lighter upon prolonged standing. The author thinks, that the solid, by surface action, will attract and condense on its surface what little water is contained in the Glycerin.

281. 1864. TATE, T. On the magnitude of a drop of liquid formed under different circumstances. *Phil. Mag.*, (4) Vol. 27, p. 176.

The substance of this paper is expressed in the following abstracts:

1)—Other things being the same, the weight of a drop of liquid is proportional to the diameter of the tube in which it is formed. (This connected with Jurin's Law, (see No. 16,) leads to the following conclusion:)

2)—The weight of the drop is in proportion to the weight of water which would be raised in that tube by capillary action.

3)—The weight of drops of a liquid, other things being the same, is diminished by an augmentation of temperature.

4)—In different solutions of Chlorid of Sodium, or other neutral salts, the increment in the weight of the drops is in proportion to the weight of the dry salt in solution.

282. 1864. TOMLINSON. On a new variety of the Cohesion figures of liquids. (Submersion figures.) *Phil. Mag.*, (4) Vol. 27, p. 426.

Describes and gives illustrations of a new class of figures obtained by placing a drop of a liquid upon the surface of another, in which it sinks to the bottom. A typical example is afforded by a solution of Cochineal dropped into water. In some cases (e g., Bitter Almond Oil and Benzol) liquid rings are produced, the formation of which he discusses. (Compare No. 256.)

283. 1864. TOMLINSON. Cohesion and Submersion figures. *Phil. Mag.*, (4) Vol. 28, p. 354.

Continues to utilize the phenomena of Cohesion and Submersion figures for the detection of adulterants in oils; e. g., Poppy Oil and Olive Oil, Illustrations of these beautiful phenomena are given. (See No. 282.)

284. 1865. CHEVREUL. Extrait d' un Mémoire sur des phénomènes d' affinités capillaires. *Comptes Rendus*, Vol. 63, p. 61-69. See also *Jahresb. f. Chem.*, 1866, p. 8.

Institutes a series of experiments demonstrating the displacement of oils by water, or water by oils, from their respective intimate contact with certain mineral bodies, as White Lead, Kaolin, etc. This is with a view of applying the results to the arts of painting and varnishing and to agriculture.

285. 1866. MEYER, O. E. Ueber die Strömung von Gasen durch Capillarröhren. *Pogg. Ann.*, Vol. 127, p. 253-281 and p. 353-382.

For the motion of gases through capillary tubes he arrives theoretically at a law exactly corresponding to that of Poiseuille and Hagenbach for the flow of liquids through capillary tubes. (See No. 246.) In order to test the correctness of this law he applies thereto in detail the experimental data recorded by Graham. (See No. 254.)

286. 1866. ECKHARD, C. Der gegenwärtige experimentelle Thatbestand der Lehre von der Hydrodiffusion durch tierische Membranen. *Pogg. Ann.*, Vol. 128, p 61-100.

The following is an abstract of the author's conclusions:

1)—In equal times there is an equal amount of diffusion, (in both directions,) i. e., the endosmotic equivalents remain the same.

2)—The endosmotic equivalents remain constant at temperatures varying within certain limits.

3)—Dried membranes cause a higher endosmotic equivalent than fresh ones, (because the salt current is diminished, while the water current remains unchanged.

4)—Velocity of diffusion increases with temperature according to a definite law, which he found empirically.

5)—It also increases with concentration; both the salt current and the water current become faster, the water current more so than the salt current, hence their quotient, i. e., the endosmotic equivalent, increases.

287. 1866. ROGER, E. Mémoire sur les phénomènes capillaires. *Comptes Rendus*, Vol. 62, p. 134-138.

The author states that the commonly accepted hypothesis, that in capillary phenomena the action of molecular forces becomes altogether imperceptible at the smallest perceptible distances, is not precisely correct.

He introduces a formula expressing a relation between the height of capillary rise and the diameter of the tubes, containing a correction for the action of the solid upon the fluid at very small, yet perceptible distances. The correctness of his formula he tested by applying thereto the accurate experimental results of Simon de Metz. (See No. 202.)

288. 1866-1868. DUPRE, A. Théorie Mécanique de la Chaleur. *Ann. Chim. Phys.*, (4) Vol. 7, p. 236-282 and p. 406-428. Vol. 9, p. 328-384. Vol. 11, p. 194-220 (1867) and Vol. 14, p. 64-143 (1868.)

The author applies the results of preceding memoirs concerning the gaseous state of matter, latent heat and molecular energy to the study of capillary phenomena upon thermodynamic principles.

In Vol. 7, the force of attraction and separation of surfaces is considered both theoretically and experimentatly.

Vol. 9 contains the laws of molecular forces as applied to capillarity proper and the various phenomena connected with it.

Vol. 11 speaks of the influence of temperature and pressure in the capillary phenomena. In this connection it is of interest to note the following fact herein strikingly demonstrated, viz., that the height of the column in a capillary tube will not be sensibly affected by heating the mass of fluid abovè which it rises, as long as the meniscus itself retains its temperature. If heat is applied to the meniscus direct, the column will sink.

In Vol. 14 interesting relations between molecular attraction and chemical equivalents are established.

289. 1866. DUPRE. *Théorie Mécanique de la Chaleur.* Chap. IX, 206. Capillarité. (See No. 288.)

290. 1866. WATTS. *Dictionary of Chemistry,* Vol. I, London. 1866. "Capillarity." See also Ed. of 1894.

291. 1866. LAMARLE. Theorie der Stabilität flüssiger Lamellensysteme. *Pogg. Ann.,* Vol. 128, p. 477. From *Bull. Acad. Belg.,* (2) Vols. 17 and 20.

Lamarle, by theoretical considerations, establishes the laws according to which liquid films, when attached to wire frames of special shapes, must combine and arrange their edges, if a stable lamellar system is to be produced.

292. 1867. PLATEAU, J. Title as in No. 182. *Pogg. Ann.,* Vol. 130, p. 149-159, 6th series, and p. 264-277, 7th series. From *Mém. Acad. Bruxelles,* Vol. 33.

A theory is given of fluid Laminar Systems, supported by experiments with wire frames dipped into the film-producing liquid.

293. 1867. DAGUIN. *Traité de Physique.* Third edition, Paris, 1867. Vol. I, p. 209.

294. 1867. VOIT, E. Ueber die Diffusion von Flüssigkeiten. *Pogg. Ann.,* Vol. 130, p. 227 and p, 393.

Sought to determine the constants of diffusion (see Fick, No. 214.) of Grape Sugar and Cane Sugar solutions, ascertaining the per centage of the diffusing layers at regular intervals of time by means of a Soleil-Dubosque's Saccharimeter sliding vertically. (Compare No. 228.)
For Cane Sugar he finds the constant to be 0.8144.
For Grape Sugar . . . . 0.8180.
The gradual march of the process of diffusion as observed in these experiments, is illustrated by lucid diagrams.

295. 1867. PLATEAU, F. Umwandlung eines flüssigen Cylinders in gesonderte Kugeln. *Pogg. Ann.,* Vol. 132, p. 654.

The tendency of a long liquid cylinder of small diameter to contract into a succession of small globules, is here demonstrated by placing a suitable thread of cotton, weighted at one end, vertically into water or olive oil, and then dexterously withdrawing it; the phenomenon succeeds better if the thread is stretched horizontally, dipped into the liquid and withdrawn.

296. 1867. MENSBRUGGHE, G. VAN DER. On the Tension of liquid films. *Phil. Mag.,* (4) Vol. 33, p. 270-282. From *Bull. Acad. Belg.,* (2) Vol. 22. Also *Pogg. Ann.,* Vol. 133, p. 277-292.

Demonstrates the existence of a contractile force in soap films. employing under certain precautions flexible threads of cotton or light metallic rings. Evolves the laws of equilibrium for the cases mentioned.

297. 1868. MENSBRUGGHE, G. VAN DER. On the tension of liquid films. *Pogg. Ann.,* Vol. 134, p. 455-468, From *Bull. Acad. Belge.,* (2). Vol. 23.

Theoretical investigations regarding the equilibrium of liquid films. (See No. 296.)

298. 1868. BECQUEREL, M. On the chemical effects produced in capillary spaces. *Phil. Mag.*, (4) Vol. 36, p. 437-445, (1868.) From *Comptes Rendus*, 1867 and 1868.

The following reaction is a type of the phenoma discovered and elaborated upon by the author. A glass tube with a crack of not more than capillary width is filled with a concentrated solution of Nitrate of Copper, and this tube then inserted into a test glass containing a solution of Monosulfid of Sodium of definite strength, the surfaces of the two liquids being brought to the same level. After a short time, a very brilliant deposit of metallic Copper, (not Copper Sulfid as should be expected,) of crystalline texture appears, increasing in thickness, little by little, enlarging the crack, until the tube breaks. Small cylinders of copper, 2 millims. in diameter could be obtained in this manner.

Similar reductions took place with Salts of Silver, Lead, Gold, Tin, Cobalt and Nickel; also when employing capillary spaces of different (and more convenient) forms. These phenomena, according to Becquerel are due to the combined action of affinity, molecular attraction and electricity.

299. 1868. BULIGINSKI, A. Untersuchungen über die Capillarität einiger Salzlösungen bei verschiedener Concentration. *Pogg. Ann.*, Vol. 134, p. 440-454.

The constants of Capillarity were carefully determined for solutions of KNO_3 and NH_4Cl both of different strengths at three distinctly different temperatures. It was observed that the solutions of Ammonium Chlorid have higher capillarity than water, and increase in capillarity with concentration. (See Valson, No. 311.)

300. 1868. SACHS. *Lehrbuch der Botanik*, Leipzig, 1868. Capillarität, p. 520.

301. 1868. QUINCKE, G. Ueber die Capillaritäts-Constanten fester Körper. *Pogg. Ann.*, Vol. 134, p. 356-367.

The author advocates the existence of a surface tension in solid bodies, especially in substances which have been allowed to cool from the liquid (melted) condition. Examples: Glass, drawn wires, putty. The molecules of such surfaces, not being disturbed while assuming their equilibrium, this explains the excessive hardness of these surfaces. The author determines the constant of Capillarity for several metals from the weight of drops formed upon fusing these metals.

302. 1868. QUINCKE, G. Ueber die Capillar-Constanten geschmolzener Körper. *Pogg. Ann.*, Vol. 135, p. 621-646.

Determines the Constants of Capillarity ("Specific Cohesion") of many fusible substances by weighing the drops which they form upon being heated above their melting points. In this manner he finds remarkable relations. Thus, if the volume of a drop of sulphur is ONE, that of Silver, or Mercury dropping through the same tube is 2, of Gold about 3, of Water, or Borax, or Soda, 4, of Zinc, 6, of Sodium, 12, of Potassium, 20.

303. 1869. ANDREWS, TH. On the continuity of the gaseous and liquids states of matter. *Philos. Trans.*, 1869, p. 159 and 575. Also see *Pogg. Ann.*, Erg. Vol. 5, p. 64. *Phil Mag.*, (4) Vol. 39, p. 150-153, (1870.)

When Carbonic Acid gas is compressed at temperatures at or below the critical point (30.9° C) a definite degree of pressure will produce liquefaction attended by a sudden and plainly noticeable contraction of volume. But at higher temperatures, say 48° C, and under the influence of an excessive pressure, no sudden passage from the gaseous into the liquid condition is observed. This transformation is effected by a series of gentle gradations. Hence the author concludes that the gaseous and the liquid states are only but widely separated forms of the same condition of matter.

304. 1869. QUINCKE, G. Ueber die Capillar-Constanten geschmolzener chemischer Verbindungen. *Pogg. Ann.*, Vol. 138, p. 141-155.

Determines the "specific cohesion" of various salts, metals and organic substances, etc., by a new method, viz., measuring certain dimensions of drops formed by fusing these substances, and calculating the specific cohesion according to a simple algebraical relation. He finds the law confirmed according to which the specific cohesion of a number of substances present striking regularities. (See No. 302.)

305. 1869. BEER, AUG. *Einleitung in die mathematische Theorie der Elasticitaet und Capillaritaet, Leipzig, 1869.*

306. 1869. LUEDTGE, R. Ueber die Ausbreitung von Flüssigkeiten auf einander. *Pogg. Ann.*, Vol. 137, p. 362.

Studying the expansion of liquids upon liquids, he finds that upon arranging them according to their constants of capillarity, beginning with the smallest number, each liquid of the series will spread upon any one following, e. g., Alcohol will spread on Poppy Oil, the latter on water, etc. An exception occurs with regard to Mercury and water, as the latter seemingly does not spread on the former. QUINCKE however, has later succeeded in producing this phenomenon. (See No. 312.)

307. 1869. QUINCKE, G. Ueber die Entfernung, in welcher die Molecularkräfte der Capillarität noch wirksam sind. *Pogg. Ann.*, Vol. 137, p. 402.

He determines the distance of molecular action by the following method: Upon a clean glass plate is deposited a thin sheet of silver in wedge shape, leaving part of the glass uncovered. When the plate thus prepared is dipped into water, the glass is wetted, the silver part is not wetted. Adjoining the free glass part there is a silver zone where the boundary line presents an intermediate condition, owing to the molecular action of the underlying glass upon the water. Hence the spot at which the boundary line becomes uniformly convex, also indicates the limit of the sphere of action of the glass molecules. It only remains to measure the thickness of the film at that particular spot to obtain the radius of molecular action. For glass, silver and water, for example, it was found to be greater than 0.0000542 mm. (See Plateau, No. 261.)

308. 1869. VALSON, ALPH. Sur les actions moléculaires dans le chlore, le brome et l'iode. *Comptes Rendus*, Vol. 69, p. 1140. See also *Jahresber. f. Chem.*, 1869

He sought to establish a capillary relation between the elements Chlorin, Bromin and Iodin, by dissolving molecular quantities of the respective Potassium Salts in the same volume of water, and observing the height of rise of the solution in a capillary tube of 1 mm. diameter. The values thus obtained together with the results of additional experiments on the three corresponding Cadmium salts, exhibit a regularity similar to that existing among the atomic weights, and other physical properties of the three Halogens.

309. 1870. DUCLAUX, E. Sur la tension superficielle des liquides. *Ann. Chim. Phys.*, (4) Vol. 21, p. 378-435.

Gives an historical development of the notion of surface tension of liquids, making on this basis a special study of Drops with practical applications (Drop Alcoholometer), and of the stability of Emulsions. In the latter respect, he concludes that the emulsions formed by the mixture of two liquids are the more stable, the nearer the surface tension of the constituents, the nearer their densities and the greater their viscosity. (Compare No. 321.)

310. 1870. MENSBRUGGHE, G. VAN DER. Sur la tension superficielle des liquides considérée au point de vue de certains mouvements observés à leur surface. *Ann. Chim. Phys.*, (4) Vol. 20, p. 121-135.

Like Segner and Thomas Young, the author advocates the existence of a surface tension in fluids, having an equal magnitude in all points of the surface at the same temperature. If this tension is affected at any one point by an outside influence, e. g., the approach of a more or less volatile substance of different surface tension, a motion is necessarily produced upon the surface of the fluid; centrifugal, when the aproaching body has a smaller, centripetal, when it has a greater surface tension. Numerous illustrative examples are given.

311. 1870. VALSON, ALPH. Etude de l'action moléculaire fondée sur la théorie de l'action capillaire. *Ann. Chim. Phys.*, (4) Vol. 20, p. 361.

Studying the capillary behavior of salt solutions, the author found the following interesting laws of "Capillary moduli": He prepared Normal saline solutions containing one gramme-equivalent of salt in one liter of water, and determined the capillary rise in the same tube, using two series of Normal solutions having two fixed metals or metallic radicals as their basis, (say Ammonium and Cadmium,) and varying acid radicals combined with these metals. He found for example, that the difference in the capillary rise of the Chlorids is the same as that of the Bromids or the Sulfates. In this case if the rise of the NH_4 salt assumed to be=0, the constant (or modulus) for Cd=4.8. The author gives a table assigning to each metal its capillary modulus.

A similar table of constants is obtained when reversedly two acid radicals are taken as the basis, and the metals vary. Solutions of Ammonium chlorid and Lithium chlorid possess a higher capillarity than even water, (see No. 299,) and, by a remarkable coincidence, these two substances are also distinguished by possessing a higher index of refraction than water.

312. 1870. QUINCKE, G. Ueber die Capillaritäts-Erscheinungen an der gemeinschaftlichen Oberfläche von Flüssigkeiten· *Pogg. Ann.*, Vol. 139, p. 1-81.

He is the first to obtain numerical values for the Constants of Capillarity at the zone of contact of two immiscible liquids. Makes use of his new method of determining these constants, (see No. 304,) which consists in measuring certain dimensions of flat drops of the liquid, reposing either in air or another liquid. The constant of Capillarity (by him called specific cohesion) is a function of these dimensions. The results of these extensive investigations, covering all the important phases of Capillarity, are finally summarized.

313. 1870. STAHL, M. Ueber einige Punkte in der Theorie der Capillaritäts Erscheinungen. *Pogg. Ann.*, Vol. 139, p. 239.

Theoretical considerations, intended to vindicate Laplace's theory. (See No. 64.)

314. 1870. DUBOIS-REYMOND P. Ueber den Einfluss der Capillarität auf die Erscheinung der Ausbreitung der Flüssigkeiten. *Pogg. Ann.*, Vol. 139, p. 262-275.

If a drop of a fluid is placed upon the surface of another fluid, it will expand or not according to the magnitude of the edge angle of the drop. This angle is a function of the surface tensions at the common surface of the two fluids and air, as expressed in NEUMANN'S THEOREM, (which is explicitly detailed in the paper.) He then seeks to give explanation of the swift currents of a fluid caused by vapors approached, antagonizing the view of Mensbrugghe on this point. (See No. 310.)

315. 1870. LUEDTGE. Ueber die Spannung flüssiger Lamellen. *Pogg. Ann.*, Vol. 139, p. 620.

Regarding the tension of liquid lamels he arrives at the following conclusion; 1) Liquid films immediately after their formation acquire a thickness less than the double radius of the molecular sphere of action; hence the cohesion of a film is not constant but a function of its thickness. 2) The tension of a liquid film increases when thickness decreases. (See however No. 323.)

316. 1870. WARBURG. Ausfluss von Quecksilber aus gläsernen Capillarröhren. *Pogg. Ann.*, Vol. 140, p. 369.

Contrary to Poiseuille's results which the latter obtained for Mercury, (see No. 163,) Warburg found that the quantity of Mercury flowing through a capillary glass tube is in proportion to the 4th, not the 3rd power of the radius of the tube.

317. 1870. BOLTZMANN, L. Ableitung der Grundgleichungen der Capillarität aus dem Prinzip der virtuellen Geschwindigkeiten. *Pogg. Ann.*, Vol. 141, p. 582-590.

Purely theoretical considerations. (Compare Gauss, No. 115.)

318. 1870, MENDELEEFF, D. Bemerkungen über die Untersuchungen von Andrews über die Compressibilität der Kohlensäure. *Pogg. Ann.*, Vol. 141, p. 618.

Mendeleeff denies the existence of an intermediate state between liquid and gas, as advocated by Andrews, in certain phases of the latter's experiments. (See No. 308.) Adduces in support the experiments of Caignard de la Tour and Wolf. (See No. 218.)

He accepts two kinds of limitations of the compressibility of gases. At low temperatures they yield a liquid, and at high temperatures they reach a limit of gaseous volume which merely coincides with the limit of compressibility of fluids.

319. 1870. THOMPSON, SIR W. Effect of the curvature of the surface of a liquid on the thermal equilibrium between the liquid and the vapor in contact with it. *Proc. Roy. Soc. Edinb.*, 1870, February 7th. Also see *Phil. Mag.*, (4) Vol. 42, p. 448, (1871.)

A fluid at a higher level has less vapor pressure than it has at a lower level, hence differences in curvature of liquids involve differences of vapor pressure.

If two separate portions of a liquid are placed at different levels, the difference of vapor pressure would, under ideal conditions, exert an equalizing influence by causing the fluid to evaporate from the higher level and condense into the lower.

If a capillary tube closed at the lower end and containing some water, be inserted in a larger mass of water within a vessel hermetically closed, the difference of vapor pressure outside and inside of the capillary tube will tend to restore the equilibrium, which takes place only when the fluid in the capillary tube occupies the height which it would reach by capillary-hydrostatic action, if the lower end was open. If below that height, water would condense into the tube, if above, it would evaporate from the tube.

The author evolves two formulæ expressing the exact relation between the vapor pressure and curvature of a liquid on one hand, and the differences of vapor pressure and differences of level on the other.

320. 1870. WUELLNER, Ad. *Experimentalphysik.* Leipzig, 1870. 3rd Ed., Vol. I, Capillarität, p. 245-278.

321. 1870. PLATEAU, J. J. Neues Princip betreffend die Spannung von Flüssigkeitsoberflächen. *Pogg. Ann.*, Vol. 141, p. 45.

The forces which cause liquids to foam are not so much cohesion or viscosity of the fluid, but rather their *surface viscosity* in relation to surface tension. The existence of this force is herein clearly and ingeniously established by the author, by means of a magnetic needle which was made to rotate within the surfaces of a series of fluids successively. With water and saponine solution the surface viscosity is greater, with alcohol, the surface viscosity is smaller than the inner viscosity. When the quotient between surface viscosity and surface tension is great, we have liquids producing stable foam, (Saponine—and Soap solution.) When the quotient is small, as with water, there is no or very little tendency to foam.

322. 1870. MENSBRUGGHE, VAN DER. Oberflächliche Zähigkeit der Lamellen aus Saponinlösung. *Pogg. Ann.*, Vol. 141, p. 297.

Gives experimental support to M. Plateau's discovery of the great surface viscosity of Saponine solution. (See No. 321.) The author, with the aid of an Electrophor, succeeds in obtaining open films of such a solution which have quite the appearance of solid films like mica, and are also very flexible. Some fragments being collected on a cloth, at once coalesce and form drops.

323. 1870. **MENSBRUGGHE, VAN DER.** Ueber einen durch Herrn Lüdtge angegebenen molecular-statischen Satz. *Pogg. Ann.* Vol. 141, p. 608.

If two liquid films of the same fluid material are made to close both ends of a hollow cylinder, the author demonstrates by accurate measurements that the curvature and hence the tension of the two films remains constant, even if one of these films has become so thin as to show colors. Luedtge had asserted that in the latter case the curvature is less, i. e., the tension increased. (See No. 815.)

324. 1871. **BUDDE, E.** Ein neues Experiment, und einige Bemerkungen zur Theorie des Leidenfrost'schen Phänomens. *Pogg. Ann.*, Vol. 142, p. 158.

The author succeeds in producing Leidenfrost's phenomenon very readily with water at temperatures below 100° C, by carefully excluding the air. This sustains the proposition that the force necessary to support the drop, is equal to the weight of the drop plus the atmospheric pressure which is to be overcome.

The author finally points out in what manner the form of the dish influences the shape of the drop in its motions.

325. 1871. **MOUSSON, ALB.** Bemerkungen über die Theorie der Capillarerscheinungen. *Pogg. Ann.*, Vol. 142, p. 405-417.

Gives a succinct outline of the probable constitution of matter and the forces which underlie capillary action, especially emphasizing the change in homogeneousness of liquids at their free surfaces, or at the surface of their contact with solids. This view was held before by Poisson (see No. 118,) and Wilhelmy. (See No. 280.) The author then proceeds to evolve the three main laws of capillarity upon the principle of the conservation of molecular energy.

326. 1871. **MARANGONI.** Ueber die Ausbreitung der Tropfen einer Flüssigkeit auf der Oberfläche einer anderen. *Pogg. Ann.*, Vol. 143, p. 337-354.

The author concludes that a drop of a fluid will expand on the surface of another liquid, if the surface tension of the latter is greater than the sum of the surface tensions of the lower and upper surfaces of the drop. If it is smaller, the drop retains lens shape. He further insists that the phenomena of expansion of drops can best be studied when carried out on a large scale, and describes the color phenomena which he systematically observed in experiments carried out on the large basin in the Tuileries of Paris.

327. 1872. **MENSBRUGGHE, VAN DER and TOMLINSON, CH.** On a relation between the surface tension of liquids and the Supersaturation of Saline Solutions. *Proc Roy. Soc.*, Vol. 20, p. 342-51. See also *Phil. Mag.*. (4) Vol. 44, p. 223-32.

The authors demonstrate that the state of supersaturation of a salt solution (Glauber's Salt in Water) is broken, and the salt at once crystallizes, when the surface tension of the solution is diminished by the latter coming into contact with substances of a considerably lower surface tension, like drops of Ether, Alcohol and certain Oils. The local application of heat at parts of the surface however, does not seem to diminish the surface tension sufficiently to cause the salt to crystallize.

328. 1872. **DUCLAUX, E.** Recherches sur les lois des mouvement des liquides dans des espaces capillaires. *Ann. Chim. Phys.*, (4) Vol. 25, p. 433-501.

The author makes an extensive, partly experimental study of the flow of liquids through capillary tubes, progressing to annular capillary channels of known dimensions. to porous diaphragms, and finally to animal membranes, in the latter case utilizing the results of Schmidt (see No. 220,) and Liebig. (See No. 181.)

The author concludes that the same relations that exist for capillary tubes between the quantity of outflow, pressure, and width and length of the tubes (Poiseuille's law, see No. 162,) holds good also in the more complicated cases, as far as can be ascertained.

Further paragraphs are devoted to phenomena of molecular adhesion, comprising phenomena of surface absorption, the separating action of paper and other important subjects.

329. 1872. DUPRÉ, A. On the specific heat and other physical characters of mixtures of Methylic Alcohol and Water. *Phil. Trans.* 1872, p. 331-351.

In Section IV of this memoir, the capillary rise of mixtures of methyl alcohol and water is measured. The results are tabulated and also graphically represented in a curve.

330. 1872. DECHARME, C. Du mouvement ascensionnel spontané des liquides dans les tubes capillaires. *Ann. Chim. Phys.*, (4) Vol. 27, p. 228-242.

Studying the velocity of spontaneous rise of liquids in both vertical and in inclined capillary tubes, the author finds that each liquid possesses a "capillary velocity" of its own which is the velocity of rise observed in tubes of 1 mm. diameter, and at a definite temperature, e.g., 0° C. Diagrams of curves are added which illustrate at a glance the capillary velocities of different liquids. The capillary velocities in the spontaneous ascent of liquids bear no analogy to the velocities of outflow, where pressure is employed. (Poiseuille's experiments, see No. 162.) In the latter case salts tend to accelerate the velocity of water, while with the exception of Ammonium Chloride (see No. 311.) the reverse condition takes place in the spontaneous ascent of liquids in capillary tubes.

331. 1872. MENSBRUGGHE, VAN DER. Ueber eine merkwürdige Thatsache beim Contakt gewisser Flüssigkeiten mit sehr verschiedenen Oberflächen-Spannungen. *Pogg. Ann.*, Vol. 146, p. 623. From *Bull. Acad. Belg.*, Vol. 33. Also see *Ann. Chim. Phys.* (4) Vol, 26, p. 318-321.

Whenever a fluid of great surface tension, e. g.. Water, holding gases in solution, comes into contact with a liquid of low surface tension, e. g. Alcohol, Ether, Oil of Turpentine, etc., an evolution of the gas dissolved becomes more or less apparent, (see No. 143.) The phenomena of cohesion figures (see No. 283,) are to be explained on the same principle.

332. 1872. BERGER. Leidenfrost's Phenomenon. *Pogg. Ann.*, Vol. 147, p. 472 and 474.

Criticism of articles on this subject by E. BUDDE (see No. 324,) and R. COLLEY. (*Pogg. Ann.*, Vol. 143, p. 125.)

333. 1872. BECQUEREL. Mémoire sur l'emploi des forces électrochimiques et électrocapillaires pour la formation, en proportions définies, des amalgames, et de plusieurs composés cristallisés. *Comptes Rendus*, Vol. 75, p. 1729-1733.

Continuing his former researches on chemical effects produced in capillary spaces (a fissured glass tube,) (see Nos. 99 and 298,) the author describes the mode of producing amalgams of silver and copper, and other crystallizable compounds.

333a. 1872. MAXWELL, J. CLERK. *Theory of Heat.* New York, 1872. Chapter XX, p. 260-274, treats of Capillarity.

334. 1872. GUEROUT, AUG. Sur les dimensions des intervalles poreux des membranes. *Comptes Rendus*, Vol. 75, p. 1809.

The pores of a membrane being likened to short capillary tubes perpendicular to its faces, the law of Poiseuille (see No. 162,) is thereto applied and a formula obtained, by means of which the dimensions of the pores may be calculated from given quantities experimentally to be established. Values are obtained for bladder, gold beater's skin and parchment paper, Actual measurements on fine Asbestos showed the capillary cross section to vary from 16 to 33 ten thousandth of a square millimeter, average: 24 mm. square. Calculation by the formula: 25 ten thousandth of a mm. square, hence a close coincidence.

335. 1873. QUINCKE G. Sur les couches liquides à la surface des corps solides. *Ann. Chim. Phys.*, (4) Vol. 28, p. 286-288.

The diminution of the quantity of water passing through a porous diaphragm in the unit of time while the pressure remains the same, was explained by the author in 1859, by the assumption that particles of tile are mechanically carried off and obstruct the passage. Duclaux (see No. 328,) ascribed the phenomenon to the thickening of a supposed liquid layer adhering to the pore-walls. Quincke now upholds his view, while not denying the simultaneous existence of a liquid layer less mobile, as pointed out by Bède, (see No. 243,) Wilhelmy (see No. 278,) and others. Quincke also recalls his former observation (1860,) that a mixture of alcohol and water pressed through porous tile moistened with water, comes through with a less spec. grav. than the entering fluid.

336. 1873. MEYER, O. E. Die Gültigkeit des Poiseuille'schen Gesetzes für die Transpiration der Gase. *Pogg. Ann.*, Vol. 448, p. 1-44.

The author's results demonstrate that Poiseuille's law for the flow of liquids through capillary tubes (see No. 162,) holds also good with great exactness for the transpiration of gases through capillary tubes.

337. 1873. PLATEAU, J. J. *Statique expérimentale et théorique des liquides.* 2 Vols. Paris, London, Gand and Leipzig. 1873.

"This work consists essentially of the collected series of papers "*On the figures of Equilibrium of a Liquid Mass without Weight,*" (see Nos. 154 and 292.) which the distinguished physicist of Ghent has published during the years 1848-1868. with numerous additions relating chiefly to the work of other investigators in the same field of research. The present book derives a special value and beauty from the sagacity with which the author has followed out the physical and mathematical consequences involved in the Principle of the equality in all directions of the Tension of a Liquid Surface . . . " *Phil. Mag.*, (4) Vol. 48, p. 140-141. [1874.]

338. 1873. SCHOLZ, R. Synaphie einiger noch nicht untersuchter Stoffe, insbesondere der zusammengesetzten Aetherarten. *Pogg. Ann.*, Vol. 148 p. 62–76.

Determined the capillarity of compound ethers and other liquids, making measurements both with capillary tubes and adhesion plates of various material. In the latter case he determined the force necessary to detach the disks from the liquids to be examined. (see No. 388.) Both methods lead him to establish the fact that Sulfuric Ether possesses the smallest capillarity, (Synaphy) of all fluids known, next in rank being the compound ethers.

339. 1873. BOUSSINGAULT, JOSEPH. Sur la rupture de la Pellicule des fruits exposés à une pluie continue.—Endosmose des feuilles et des racines. *Ann. Chim. Phys.* (4) Vol. 29, p. 360-367.

Fruits, leaves and roots of plants when immersed in water for definite lengths of time, behave differently as regards the exosmose of sugar. With cherries, raisins, etc.. there is exosmose of sugar and endosmose of water which causes the pellicle to burst, showing the effect of rain upon such fruits. With leaves the exosmose of sugar is much slower than with fruits. With roots and germinating rootlets of cereals, the phenomenon does not take place at all. A beet weighing 1075 gms., and containing 100 gms. of sugar, did not show the least trace of sugar in the water after a period of ten days' immersion.

340. 1873. GERNEZ, D. Note relative à l'action prétendue des liquides à faible tension superficielles sur les gaz dissous dans les liquides à forte tension superficielle. *Comptes Rendus*, Vol. 76, p. 89-92.

Adduces experiments to disprove Mensbrugghe's theory regarding the disengagement of gas dissolved in a liquid, and to prove that this is simply due to evolution of air that was absorbed upon shaking. The author also shows that upon placing a saturated aqueous solution of carbonic acid gas upon carbon disulfide, etc.. no disengagement of gas will take place, provided that dust or other solid particles are absolutely excluded. The layer of air supposed to be condensed upon their surface, would give rise to the evolution of the gas dissolved. (see No. 331.)

341. 1873. ROGER, E. Théorie des phénomènes capillaires. Fourth memoir. *Comptes Rendus*, Vol. 76, p. 816-819.

Simon de Metz (see No. 202,) had observed that for diameters of tubes below 0.008 mm. the capillary rise seemed to be much higher than simply in inverse proportion to the diameter of the tube, (see No. 16.) The present author through mathematical reasonings arrives at a formula which takes into account this increase of capillary rise. The experimental results of Simon are in good accord with those calculated from the formula.

342. 1873. M. BECQUEREL. Mémoire sur les actions produites par l'attraction moléculaire dans les espaces capillaires. *Comptes Rendus*, Vol. 76, p. 1034-1041.

If two salt solutions capable of forming an insoluble precipitate, e. g., Potassium Sulfate and Barium Chloride are placed in glass vessels and are connected by a fissure having a width of less than several thousandth of a millimeter, the chemical reaction induced by the capillary space takes place so slowly that the product is formed in a crystalline condition. Thus crystallized Lead Chromate and Barium Sulfate were obtained. Such solutions may be in contact with each other within an extremely narrow fissure, without reacting upon each other. In wider fissures, one of the fluids passes and slowly causes a precipitate which creeps along the wall of the cracked tube.

343. 1873. LIPPMANN, G. Relation between Capillary and Electrical Phenomena. *Pogg. Ann.*, Vol. 149, p. 546, (1873.) See also *Comptes Rendus*, Vol. 76, p. 1407, or *Philos. Mag.*, (4) Vol. 47, p. 281-291, (1874.) and *Ann. Chim. Phys.*, (5) Vol. 5, p. 494, (1875.)

These interesting papers demonstrate the cause of the frequently observed inconstancy in the Constant of Capillarity for mercury, which was ascribed by Quincke (see No. 284,) to impurities of the surface. *First law:* The capillary constant at the common surface of Mercury and dilute Sulfuric acid is a function of the electric difference (electromotive force of Polarization,) existing on this surface. The meniscus of a mercurial column in contact with dilute sulfuric acid in a capillary tube will rigidly occupy the same position, if the same electrical difference is maintained in the apparatus by establishing an electric circuit. If the weakest electric current is introduced, the meniscus will occupy another fixed position corresponding to the new electromotive force. On this principle an exceedingly sensitive capillary electrometer was constructed to measure weak electromotive forces, a compensating manometric pressure being used to bring the meniscus back to its zero point.

The capillary constant increases with the electric difference introduced, reaching a maximum at e=0 9 Daniell, then decreases until 2 Daniell is reached.

Second law: A mechanical enlargement of the mercurial area in contact with dilute sulfuric acid (e. g., the mere inclination of the vessel containing both, or dropping Mercury through a funnel into dilute sulfuric acid,) gives rise to an increase of electric difference, (indicated by an inserted galvanometer,) hence an increase of surface tension (constant of capillarity,) subject to the maximum before mentioned.

On this principle, an Electrocapillary Motor is constructed, converting either mechanical work into electricity by the aid of capillarity or reversedly the electric current of a cell into mechanical work by the aid of the same class of phenomena.

344. 1873. HUEBENER, TH. Untersuchung über die Transpiration von Salzlösungen. *Pogg. Ann.*, Vol. 150, p. 249–259.

The author measured the time required by equal volumes of salt solutions of related Substances and having the same specific gravity, to pass through one and the same capillary tube. For solutions of NaCl and KCl of equal specific gravity, the velocities of outflow were in inverse ratio to the equivalent weights of these salts, with the chlorides of the alkaline earths, the approximation was not so perfect.

345. 1873. DECHARME, C. Effets frigorifiques produits par la capillarité jointe à l'évaporation. *Comptes Rendus*, Vol. 77, p. 998 and 1157.

Treats of the formation of cauliflower-like crystals of water derived from the moisture of the air, which are formed when a porous substance as e. g., filtering paper dips into a layer of carbon disulfide.

346. 1873. DECHARME, C. Du mouvement ascendant spontané des liquides dans des espaces très étroits, (bandelettes de papier spongieux,) comparé au mouvement ascendant des mêmes liquides dans les tubes capillaires. *Ann. Chim. Phys.*, (4) Vol. 29, p. 415–425.

The author extended his former studies (see No. 330,) comparing the *velocity* with which different liquids rise in capillary tubes and in strips of filtering paper. Both media show analogies as well as differences. Each liquid has its own peculiar *capillary velocity* as well as its own capillary height of rise. A liquid that finally rises highest, has not necessarily the greatest capillary velocity. Curves are plotted to illustrate the various velocities. With capillary tubes, only an aqueous solution of salammoniac has a greater capillary velocity than water; with filtering paper, however, 40 liquids out of 207 have a greater velocity and finally rise higher than water, e. g., HCl, HNO_3, $Ca\ Cl_2$ etc. Moist condition of the surrounding air markedly favors the rise of fluids in bibulous paper.

347. 1873. DECHARME, C. Du mouvement descendant des liquides, comparé à leur mouvement ascendant spontané dans les tubes capillaires. *Ann. Chim. Phys.*, (4) Vol. 29, p. 564–569.

Raise the liquid by suction to double the height to which it would rise spontaneously by capillarity; then release and notice *Velocity of Descent*. The duration of the descending movement, for a great number of liquids is greater than the ascending movement with which it corresponds.

348. 1874. GUEROUT, AUG. Recherches sur l'écoulement des liquides dans les tubes capillaires. *Comptes Rendus*, Vol. 78, p. 351.

Verifies Poiseuille's law (see No. 162,) for the special case of the flow of water through vertical capillary tubes, the lower end of which dips into the lower water surface, when the ratio between charge and length of tube is constant. Another series of experiments developed the remarkable phenomenon that the mean velocity of outflow (i. e. quantity of outflow divided by cross section of the tube,) increased when to the lower orifice ivory disks with circular holes of known and successively decreasing diameter were adapted. Thus the liquid may be supposed to move in concentric cylinders animated with increasing velocity towards the center. Another theory admissible is based on certain observations by Tresca.

349. 1874. ONIMUS, M. De l'influence des substances albuminoides sur les phénomènes électrocapillaires. *Comptes Rendus*, Vol. 78, p. 643.

The interposition of a capillary space between two fluids capable of reacting with each other, produces an electrocapillary phenomenon, and the interposition of albumen may be expected to have the same effect. Solutions of Coppersulfate and Potassium oxalate separated in a U tube by a layer of albumen, formed crystals of the double oxalate of Copper and Potassium.

350. 1874. BECQUEREL. On Chemical Actions in Capillary Spaces. *Jour. Chem. Soc. Abst.* 1874, p. 1126, from *Comptes Rendus*, Vol. 79, p. 82-87.

In the reduction phenomena with fissured tubes, (see No. 333,) the chemical action is due to a strong electromotoric force developed. When this force is weaker, as e. g., with parchment paper, or dried collodion, only oxides and related products are formed.

In this manner were obtained $Cu\ (OH)_2$ in blue crystals from Sodium aluminate and Copper nitrate, and crystallized alumina from Potassium aluminate and aluminum chloride, the latter solution being placed into the parchmented tube. The author discusses the probable bearing of these phenomena upon processes in nature.

351. 1874. GUEROUT, AUG. **Influence de la température sur le coefficient d'écoulement capillaire des liquides.** *Comptes Rendus*, Vol. 79, p. 1201.

The coefficient of capillary effusion being here defined as the quantity of a fluid passing in one second through one and the same capillary tube and expressed in mm. cubes, this quantity is constant for one and the same liquid at one and the same temperature, and indicates for varying liquids their degree of *mobility*.

For water and certain salt solutions the increase in capillary mobility with the temperature (from 10° to 20° C,) is represented by a straight line. An elevation of 10° C. increases the mobility of water by one third.

352. 1874. OBERMAYER, A. v. **Ueber Ausbreitungserscheinungen einiger Lösungen von Anilinfarben auf Wasser.** *Pogg. Ann.*, Vol. 151, p. 130.

Observes in the expansion of solutions of aniline colors upon the surface of water a confirmation of Van der Mensbrugghe's theory, (see No. 331,) that motion is caused by the diminution of the surface tension of water in contact with a liquid of less surface tension.

353. 1874. SIEMENS, W. v. **Capillar Galvanoskop.** *Pogg. Ann.*, Vol. 151, p. 639.

Is a modification of Lippmann's Capillary Electrometer, (see No. 348,) with a view to employ it in the measurement of resistances of submarine cables on board of ships where the unsteady oscillations preclude the use of Lippmann's Apparatus.

354. 1874. BAUMGARTNER, G. **Ueber den Einfluss der Temperatur auf die Ausflussgeschwindigkeit von Wasser aus Röhren.** *Pogg. Ann.*, Vol. 153. p. 44–52.

The quantities of flow of water through tubes of varying lengths and diameters (not capillary) were determined. With some tubes, a maximum of outflow was reached for definite temperature which decreased upon further increase of temperature. In some instances a double maximum seems to occur.

Hence, wider tubes than capillary obey the same exceptions as do capillary for tubes below a certain length, (see No. 162.) The longer the tube, the higher the maximum of outflow.

355. 1874. QUINCKE, G. **Ueber die angeblichen Beziehungen zwischen den capillaren und electrischen Erscheinungen.** *Pogg. Ann.*, Vol. 53, p. 184.

Contrary to Lippmann's experience, (see No. 348,) the author can perceive no connection between the constant of capillarity at the common surface of Mercury and a surrounding fluid, and the electromotive force there originating. The surface tension at the common surface of mercury with liquids conducting electricity is changeable by electrolysis, and may decrease or increase with direction and duration of electric current.

It is not permissible to measure electromotive forces by the magnitude of this surface tension, since accidental and unavoidable impurities materially modify the surface tension of Mercury and other fluids.

356. 1874. MEYER, OSKAR EMIL. **Hydraulische Untersuchungen.** *Pogg. Ann.*, Jubelband, p. 1–10.

Some important literature on the flow of water through tubes is pointed out, (G. Hagen, 1854 and 1869, G. G. Stokes, *Phil. Trans.* 1847, etc.) The author had an unusual opportunity to study the flow of water through a lead pipe of 3000m. length and 7mm. diameter. One of the interesting results is that pressure (a sudden shock,) exerted at one end of the column, is transmitted through water with a velocity of about 1000 meters per second, which approximates the velocity of sound in water, which is 1400 meters.

357. 1874. MEYER, OSKAR EMIL. Bemerkungen zu der Abhandlung des Herrn Dr. G. Baumgartner, (see No. 354.) *Pogg. Ann.*, Vol. 153, p. 619–621.

The author points out that Baumgartner's results on the influence of temperature upon the velocity of the flow of water through tubes had been anticipated exhaustively by Hagen in 1869, and also by the author himself, (see Nos. 356 and 285.) He found the general law of outflow for wide and narrow, long and short tubes. In the special case of long and narrow tubes, Poiseuille's law (see No. 162,) for short and wide tubes Torricelli's Theorem becomes apparent. A formula expressing this general law, was established and Baumgartner's observations, (see No. 354,) are now utilized to corroborate the correctness of the formula.

358. 1874. LASSWITZ, K. Ueber Tropfen an festen Körpern, insbesondere an Cylindern. *Pogg. Ann.*, Erg. Bd. 6, p. 441–447.

Evolves mathematical expressions for the dimensions of drops generated in contact with solids of various shapes. From the formulae a number of interesting laws are deducible bearing on the geometrical properties of drops.

359. 1874. STEFAN, J. Experiments on Apparent Adhesion. *Phil. Mag.*, (4) Vol. 47, p. 465–466. From *K. Acad. Wiss. Wien.*, 1874.

The phenomenon of separating two plates adhering to each other is not a statical, but a *dynamical* problem; the smallest force effects a separation; only the time in which a measurable distance is reached becomes the greater, the smaller the force. By theoretical considerations an equation is established which expresses all the experimental laws here arrived at.

360. 1874. DECHARME, C. Du mouvement ascendant spontané des liquides dans les tubes capillaires. *Ann. Chim. Phys.*, (5) Vol. 1, p. 145-208 and p. 318–342.

Increase of temperature diminishes the total height of capillary rise of liquids, but increases their capillary velocity, (see No. 380.) Ammonium chloride and Lithium chloride are the only substances whose aqueous solutions rise higher by capillarity than water. The paper also deals with the capillary rise in inclined tubes, and the second part treats this whole class of phenomena mathematically.

361. 1874. MARIGNAC, C. Recherches sur la Diffusion simultanée de quelques sels. *Ann. Chim. Phys.*, (5) Vol. 2, p. 546–581.

Graham's method (see No. 198,) was employed to study the diffusibility of mixed salt solutions, especially of salts not reacting with each other to form double salts. A simple relation between the diffusibility of the mixture and that of its constituents was not observable. Mixture of two salts in all cases seemed to diminish the diffusibility of the less diffusible. The same value of simultaneous diffusibility was obtained, whether the mixture was one of equal proportions or of equivalent quantities.

362. 1874. DECHARME, C. Du mouvement ascendant des liquides dans les corps poreux. *Ann. Chim. Phys.*, (5) Vol. 3, p. 417–421.

Records the time of rise and the height of rise of water in a variety of organic tissues and inorganic substances. A diagram of curves illustrates the results at a glance.

Water, while surpassed in capillary rise in filtering paper by many solutions (see No. 346,) reasserts itself in more densely porous substances.

363. 1875. EXNER, FRANZ. Ueber den Durchgang der Gase durch Flüssigkeitslamellen. *Pogg. Ann.*, Vol. 155, pp. 321–337 and pp. 443–464.

The diffusion of gases through liquid films, as studied before by Draper (see No. 186,) and Marianini, obeys a law different from that for diffusion of gases through porous solid bodies, where the density of the gas is the sole determining factor, (see No. 130) With liquid films, the absorbability of the gas by the liquid evidently exerts a powerful additional influence. The author's method was to observe the diffusion of one gas into another through a movable soap film that bounded one of the gases contained in a glass tube open at one end. A constant pressure was thus maintained. The ratio of volumes before and after diffusion determined the diffusibility of one gas into the other. In cases where too rapid diffusion tended to destroy the film, the measuring of the diameter of gas bubbles before and after diffusion had to be resorted to. With air and illuminating gas the ratio of diffusion was 2.27, but with air and ammonia this ratio was more than 46,000. The author concludes that the ratio depends on the combined influence of the density of the gas and its absorbability by the liquid film.

364. 1875. ANDREWS, TH. Preliminary notice of further researches on the Physical properties of matter in the liquid and gaseous states under varied conditions of pressure and temperature. *Proc. Roy. Soc.*, Vol. 23, p. 514–21, (1875.) Also see *Phil. Mag.*, (5) Vol. 1, p. 78–84, (1876.) and *Ann. Chim. Phys.*, (5) Vol. 8, p. 555–60, (1876.)

The laws of Boyle, Gay-Lussac and Dalton are applicable only to gases far distant from their critical points and are absolutel yinvalid for strong pressures; e. g., Carbonic acid gas at 63.7° C, when subjected to a pressure of 223 atmospheres yields a volume about half of that predicted by Boyle's law.

365. 1875. MENSBRUGGHE, VAN DER. La Théorie capillaire de Gauss et l'extension d'un liquide sur un autre. *Bull. Brux.*, Vol. 39, p. 375–384.

Not accessible.

366. 1876. GUEROUT, AUG. Recherches sur le coefficient d'écoulement capillaire. *Comptes Rendus*, Vol. 81, p. 1025, (1875,) and Vol. 83, p. 1291, (1876.) See also *Jour. Chem. Soc. Abst.*, 1877, p. 573.

The "capillary mobility" (see No. 351,) was determined for certain alcohols of the fatty and certain hydrocarbons of the benzene series, but no general law became apparent. Methylalcohol has the highest, Amylalcohol the lowest degree of mobility of the first series examined.

The examination of fatty acids and a series of esters would indicate that isomeric bodies of similar chemical nature have coefficients closely alike, while there are considerable differences for example between the mobility of a fatty acid and an ester that is isomeric with it as e.g. between butyric acid (129.5) and ethyl acetate (450.8.)

367. 1876. BECQUEREL, M. Note sur les réductions métalliques produites dans les espaces capillaires. *Comptes Rendus*, Vol. 82, p. 354.

A fissured tube containing a solution of the salt of a metal, e. g. Nitrate of Copper or Cobaltous chloride is placed into a solution of Sodium Sulfide. If the fissure is not too narrow, diffusion takes place and the sulfide of the metal forms on the side of the tube in contact with the metallic salt. The sulfide will spread around the fissure and cover the wall of the tube thus forming a capillary space between itself and the glass wall, which gives rise to chemical reduction and the formation of a brilliant coating of the metal, (see No. 350.) Variations of this experiment are described and its bearing upon physiological phenomena discussed.

368. 1876. CHEVREUL, E. Note sur l'affinité capillaire. *Comptes Rendus*, Vol. 83, p. 682.

Beginning this line of studies in 1809, the author in 1821 called *capillary affinity* the force exhibited by certain bodies, e. g., charcoal, in abstracting odoriferous or coloring principles from solutions Copper may thus be removed from water contaminated with it. The magnitude of this capillary affinity is determined by quantitative analysis of the solutions before and after the capillary reactions. The absorbent action of massicot or calcined litharge upon lime water, strontian water and baryta water are studied herein by the method indicated.

369. 1876. WROBLEWSKI, S. VON. Ueber die Diffusion von Gasen durch absorbierende Substanzen. *Pogg. Ann.*, Vol. 158, p. 539–568.

For the diffusion of Carbonic acid gas and Hydrogen through a caoutchouc membrane, and for pressures ranging from 740 to 20 mm., the author finds that the velocity of diffusion of a given quantity of gas is in direct ratio to the pressure of the diffusing gas upon the membrane. This law was also found to hold good for mixtures of the gases mentioned.

370. 1876. SONDHAUSS, CARL. Ueber flüssige Lamellen. *Pogg. Ann.*, Vol. 157, p. 73–102.

Various liquids have the property of forming liquid films in different degrees, a subject already considered by Plateau. (See No. 200.)

By special contrivances (a metallic triangle one side being movable,) the film forming power of various liquids can be compared. The author especially used a series of 10 metallic rings varying in diameter from 1 to 6 cm., and a series of larger rings up to 25 cm. diameter. and therewith examined the behavior of 45 liquids as to their film-forming property. A 8 cm. ring produced a water film, a ring of 1.4 cm. a film of Benzin; a ring of 25 cm. a film of Saponin solution. (1 in 800 parts of water.)

371. 1877. MENSBRUGGHE, G. VAN DER. On the Application of Thermodynamics to the Study of the variations of Potential Energy of Liquid Surfaces. *Phil. Mag.*, (5) Vol. 2, p. 450–458, from *Bull. Brux.*, Vol. 41, p. 769–783, (1876.) (Prelim. Comm.)

Two equations are deduced which express a general relation between thermal, electric and surface (capillary) phenomena. Each alteration of a liquid surface involves an alteration of its heat contents, viz. a lowering of temperature when the increase of surface is due to contact with a solid body not wetted by the liquid, and a rise of temperature in the converse case, e. g. when porous brick, or paper, or starch, etc., become wet with water.

Furthermore every variation of the temperature of the liquid surface involves a variation in the electrical difference, giving rise to a thermoelectric current when the circuit is closed. The laws arrived at are a generalization of G Lippmann's two laws. (see No. 348.) The constant change of liquid surfaces being attended by variations in the electrical conditions is amply exemplified in nature.

372. 1877. MENSBRUGGHE, G. VAN DER. Same subject as No. 371. Second Prelim. Comm. *Phil. Mag.*, (5) Vol. 4, p. 40–48, from *Bull. Brux.*, (5) Vol. 42, p. 21–34, (1876.)

To the two formulae of the former paper (see No. 371.) is added a third, expressing a relation between the specific heat and the surface modifications of a liquid. This third law is applied to special cases and explains numerous interesting phenomena, e. g. why minute drops of water forming clouds and mists can float in strata of air much below the freezing point without assuming the solid state; or why water resists congelation when enclosed in capillary tubes, (see No. 287.) or in organized tissues; or the curious anomaly observed by W. Spring, in the values for the specific heat of Rose's alloy near its maximum of density.

373. 1877. LIPPMANN, G. Relation entre les propriétés électriques et capillaires d'une Surface de Mercure en contact avec différents liquides. *Ann. Chim. Phys.*, (5) Vol. 12, p. 265–276.

The view expressed by the author before (see No. 348.) as antagonized by Quincke, (see No. 355.) regarding the connection between capillary and electrical phenomena is here again succinctly stated and illustrated by some well-devised experiments.

For example, two vertical capillary tubes end each into a cup above and communicate below with a wider Glass tube, also vertical. The latter is filled with mercury, which then assumes the same height in both capillary tubes if they have the same diameter. Even height is also obtained when both cups are filled with the same liquid, e. g. dilute sulfuric acid. But add a small quantity of hydrochloric acid to the acid in one cup, and the depression in the tube below becomes much greater. The same level, however, is restored, when the liquids in both cups are connected by a siphon filled with acidulated water, which equalizes the electrical potential energy of both mercurial surfaces.

The author states the meaning of the phenomena observed as follows: When Mercury is in contact with water or aqueous solutions, the addition of small quantities of certain other bodies suffices to alter two physical properties of the surface of contact, viz. electrical difference and capillary constant. Their *simultaneous* variation is subject to a simple law: For each value of electric difference at the mercurial surface there exists one value for the constant of capillarity, and *one only*, and it is independent of the chemical composition of the liquid.

374. 1877. MAXWELL, J. C. Capillary Action. *Encyclopedia Britannica.*

375. 1877. BECQUEREL. Electrocapillary Phenomena. *Journ. Chem. Soc. Abst.*, 1877, p. 820, from *Comptes Rendus*, Vol. 85, p. 169–173.

The author continues his experiments on electrocapillary effects obtained by means of cracked tubes (see No. 367.) and finds that Bismuth trichloride connected with Sodium sulfide solution by a capillary fissure, is easily reduced to metallic Bismuth, the Sulfide being formed as an intermediary product. If pulverulent materials, e. g. sand or powdered charcoal are put into the metallic solution, a metallic deposit will form throughout the whole mass.

376. 1877. REINOLD, A. W. and RUECKER, A. W. On the thickness of Soap films. *Proc. Roy. Soc.*, 1877, Vol. 26, p. 334–345.

A liquid film of soap solution when held inclined, will finally display a black zone of evidently extreme thinness. The boundaries of this zone, and especially its lower edge are characterized by a sharp increase in the thickness of the soap film. The authors made use of Plateau's soap liquid (see No. 287,) and determined the thickness of the film and the black zone by electrical measurements. The thickness of the black zone is fairly uniform and amounts to only 12 millionth of a millimeter. (Compare No. 228.)

377. 1877. VILLARI, E. De l'écoulement du mercure par des tubes capillaires. *Comptes Rendus*, Vol. 84, p. 83.

The author finds that when mercury passes through capillary tubes drop by drop, Poiseuille's law holds good, (see No. 162,) viz. that the quantity passing in a second is proportional to the pressure, proportional to the 4th power of the radius of the tube, and inversely proportional to the length of the tube, provided this length is above a certain minimum, which becomes less for narrower tubes and smaller pressures. It is also dependent on a certain constant which in turn depends on the nature of the wall and the opening.

378. 1877. QUINCKE, G. Ueber Diffusion, und ob Glas für Gase durchlässig ist oder nicht. *Pogg. Ann.*, Vol. 160, p. 118–123.

Hydrogen gas generated in each of four V shaped glass tubes closed at both ends, exerted a pressure of 27 to 54 atmospheres in 5 months, and of 25 to 126 atmospheres in 17 years; yet neither of the glass apparatus lost in weight through possible diffusion of the gas through the glass. Glass tubes containing carbonic dioxide gas under great pressure behaved in the same manner. In the latter case, the concentrated sulfuric acid employed acquired an edge angle like that of mercury, due perhaps, to a layer of gas on the inner surface of the glass.

379. 1877. MOSER, JAMES. Ueber die Torricelli'sche Leere. *Pogg. Ann.*, Vol. 160, p. 138.

If Mercury in a barometric tube is almost entirely deprived of its air, it remains suspended from the top of the tube, not exhibiting the Torricellian Vacuum, unless a slight shock is given, then it drops to its usual height of atmospheric pressure, at the same time a bubble of air rises. By removing this air through successive especially devised operations, the author succeeded in keeping a column of 160 cm. of mercury suspended, thus reaching a high degree of rarefaction upon restoring the vacuum. Yet it is very difficult to remove *all* air. (Compare No. 172.)

380. 1877. QUINCKE, G. Ueber die Cohäsion von Salzlösungen. *Pogg. Ann.*, Vol. 160, p. 337–374, and p. 560–588.

The constants of capillarity of salt solutions were determined by two methods, observation of rise in capillary tubes, and measurement of flat air bubbles in these solutions. (see No. 312.) The latter method gave results about 1-9 higher. The results are given in lengthy tables and are in part stated as follows: Equivalent quantities of different chlorides having equal amount of chlorine, added to the same quantity of water or alcohol, gave salt solutions of nearly equal cohesion or surface tension, which increased nearly in proportion to the number of added salt equivalents. The constants increase with decreasing temperature and reach a maximum near the freezing points of the solutions. Among connected subjects herein discussed is the influence of magnetism upon the cohesion of fluids.

381. 1877. JOHANNISJANZ, A. Ueber die Diffusion der Flüssigkeiten. *Wied. Ann.*, Vol. 2, p. 24-47.

The author concludes that the constant of diffusion between sodium chloride solution and water, if rather wide limits are allowed, is in accord with Fick's results, provided that diffusion taking place in the first twenty-four hours is disregarded. The author follows an ingeniously devised optical method suggested by Prof. Kundt, which permits the location at any moment of a given per centage of salt in the intermediary zone of diffusion. The march of diffusion can thus be conveniently and sharply observed. (Compare Nos. 294 and 398).

382. 1877. QUINCKE, G. Ueber den Randwinkel, und über die Ausbreitung von Flüssigkeiten auf festen Körpern. *Wied. Ann.*, Vol. 2, p. 145-194.

If a solid body (1) is in contact with a liquid (2), and if both are bounded by a third fluid or gaseous medium (3), the equilibrium of the three surfaces of contact takes place according to the laws governing the common surface of two liquids, (see No. 312). The edge-angle formed in this manner is theoretically of definite value, (see No. 63), depending solely on the nature of the 3 substances and can be calculated from the 3 surface tensions intervening by a simple mathematical expression. (Compare No. 314). The surface tensions in question may be measured by the author's method of flat drops and bubbles. (See No. 312).

The edge-angle may also be measured directly by means of reflected light. Practically, however, the edge-angle is subject to changes, due to the influence of an extremely thin film of solid or liquid or gaseous substance in contact with the solid. The edge-angle of pure water, alcohol etc., against scrupulously clean glass or metallic surfaces seems to be zero, consequently these fluids spread upon the solid surfaces mentioned. A lengthy summary of the paper is given.

383. 1877. HAGA, H. Ueber die durch das Strömen von Wasser in Capillarröhren erzengte electromotorische Kraft. *Wied. Ann.* Vol. 2, p. 326-335.

The potential difference produced by the flow of water through such capillary tubes for which Poiseuille's law (see No. 162), holds good, is in direct ratio to the pressure, independent of the length of the tubes, dependent on the condition of the inner wall of the tube, and increases with the resistance of water and probably also with temperature. These phenomena were discovered by Quincke in 1859, and studied in this special direction by Zoeliner in 1872.

384. 1877. CLARK, J. W. Ueber die beim Durchströmen von Wasser durch Capillarröhren erzeugte electromotorische Kraft. *Wied. Ann.* Vol. 2, p. 335-346.

The pressing of liquids through capillary tubes produces an electromotive force which increases with decreasing diameter of the tube. With very narrow tubes it decreases with their length. Lining the wall with different substances produces different values for the electromotive force. This force decreases with time. Its seat is in the liquid layer in contact with the wall of the tube. (See No. 383).

385. 1878. ROENTGEN, W. C. Mitteilungen einiger Versuche über Capillarität. *Wied. Ann.* Vol. 3, p. 321–328.

Wilhelmy's theory (see No. 280), that solids dipping into liquids, condense upon their surface a liquid layer of greater density than the rest of the fluid, is herein demonstrated to be untenable. A piece of gypsum suspended in water from the beam of a fine balance and tared, was split into eleven thin lamels which increased the surface 11 times. Wilhelmy's theory and calculations would involve a corresponding increase in weight by 216 mg. But the weight remained unchanged. A negative result was likewise obtained when determining the specific gravity of fine glass films of known weight and approximately known surface. (Also see Nos. 407 and 410).

The author furthermore describes a new method of measuring the difference in surface tensions of a caoutchouc membrane towards air and towards water.

386. 1878. KOLAÇEK, V. T. Ueber den Einfluss des capillaren Oberflächendruckes auf die Fortpflanzungsgeschwindigkeit von Wasserwellen. *Wied. Ann.* Vol. 5, p. 425–430, and Vol. 6, (1879) p. 616.

387. 1878. TERQUEM, A. Sur la production des systèmes laminaires de Plateau. *Comptes Rendus*, Vol. 86, p. 1057.

Unlike Plateau who employed rigid systems of metallic wires to produce soap films, (see No. 200,) the author employs flexible systems (two horizontal wires connected by two vertical flexible threads. When the system contains a liquid film (soap-syrup solution,) the surface tension causes the lower wire to be raised and the threads to assume the form of curves. Measurement of the tensile weight of the lower wire and the dimensions of the film permit the calculation of its surface tension.

388. 1878. SONDHAUSS, CARL. Ueber die Spannung flüssiger Lamellen. *Pogg. Ann.*, Ergänzungsband, VIII, p. 266–298.

The surface tension of liquid films may be determined by means of the balance; (compare Nos. 18 and 86.) a horizontal metallic ring suspended from one arm of the balance and dipping into the fluid to be examined, raises a cylindrical liquid film, whose tension is determined by the weight just sufficient to tear it asunder. The constant of capillarity calculated therefrom is checked by observations of the rise of the same liquids in capillary tubes. The surface tension of water, soap water, solution of saponin, and of mercury was thus determined and compared with the results of other investigators.

389. 1878. DUCLAUX, E. Sur la tension superficielle dans la série des alcools et des acides gras. *Ann. Chim. Phys.*, (5) Vol. 13, p. 76–101.

The author briefly reviews the results of Simon, (see No. 202,) Buliginski, (see No. 299,) Valson (see No. 311,) and Quincke, (see No. 380.) He then determines surface tension of Alcohols and volatile fatty acids by means of 2 methods, viz. capillary rise and counting drops of the various fluids contained in a given volume capable of yielding exactly 100 drops of water. The surface tension of water is taken as unit. The surface tensions in each case DECREASE with increasing percentage of the aqueous solutions; a nearly parabolic curve represents the march. Amylic alcohol reduces the surface tension of water more markedly than all other alcohols. The law is found that: The percentage of each alcohol that has the same surface tension as amylalcohol, stands to the percentage of the latter in a constant proportion.

390. 1878. THOMPSON, SILVANUS, P. On permanent Plateau's films. *Phil. Mag.*, (5) Vol. 5. p. 269–271.

These films are obtained by means of suitable wire frames (see No. 370,) dipped into a mixture of definite quantities of pure yellow rosin and Canada Balsam. The films obtained, when dried at an elevated temperature are so tough that they can sustain without breaking the pressure of a 50 gm. weight.

391. 1878. LADENBURG, A. Untersuchungen über den absoluten Siedepunkt. *Berichte d. Deutsch. Chem. Ges.*, 1878, p. 818–822.

Directions to produce as a lecture experiment certain striking phenomena of the absolute boiling point (critical point) of liquid Sulfur dioxide are herein given; thus are exhibited the great coefficient of expansion of liquids near their absolute boiling point, (see Nos. 289 and 96.) the gradual flattening of the concave meniscus and the gradual vanishing of capillary elevation, both indicative of the decrease of cohesion with rising temperature; the formation upon the slow cooling of the gasified liquid, of a characteristic thick cloud of definite outline, within which the meniscus soon appears, and which marks the first sign of condensation. (see No. 414.) The absolute boiling points were determined for SO_2, (157 to 161° C., Drion, (see No. 289,) found 140° C.) Chlorine, (148° C.) and Ether, (196° C., compare No. 218 and 96.) These values are not considered by the author to be final.

392. 1878. STEFAN, J. On the diffusion of Carbonic acid through water and alcohol. *Phil. Mag.*, (5) Vol. 5, p. 476, from *Wien. Acad. Wiss.*, 1878.

Carbonic acid gas separated from air by a liquid cylinder diffuses through the latter, the rate of diffusion being constant if the pressure is maintained constant. A number of laws of diffusibility are similarly developed. The velocities with which gases spread in liquids are of the same order as the diffusion velocities of salts with these liquids as solvents. O and N diffuse faster through Water and Alcohol than CO_2, Hydrogen diffuses fastest. (Compare No. 180.) Absorbability of gas by liquid only determines the density of the diffusion current, not its velocity; the latter is governed by the greater or lesser density of the diffusing gas.

393. 1878. STEFAN, J. On the Diffusion of Liquids. *Phil. Mag.*, (5) Vol. 7, p. 74–75, from *Wien. Acad. Wiss.*, 1878.

The results of E. Voit and Hoppe Seyler on the diffusion of sugar solutions by saccharimetric methods are discussed and compared with Fick's theory of diffusion. The deviations observed especially in the results of the optical method by Johannisjanz, (see No. 381,) are due to the fact proved by the author that a horizontal beam of light traversing a vertical plane bounding a diffusing liquid, does not remain horizontal during its passage, but is deflected.

394. 1879. STEFAN, J. On the Diffusion of Liquids. *Phil. Mag.*, (5) Vol. 7, p. 295–297, from *Wien. Acad. Wiss.*, 1879, p. 24.

Graham's results (see No. 198,) are formulated into a mathematical expression. Tables are given showing in parallel columns the salt contents in the various layers as observed by Graham, and calculated by the author, both series of values agreeing remarkably well in several series of diffusing salts. Several coefficients of diffusion at definite temperatures are recorded e. g. for Caramel, Albumen, Cane Sugar, NaCl, HCl.

395. 1879. WEBER, H. F. Untersuchungen über das Elementargesetz der Diffusion. *Wied. Ann.*, Vol. 7, p. 469–487 and 536–552.

The author establishes the correctness of A. Fick's elementary law of diffusion (see No. 314,) and declares it analogous to Fourier's law of conduction of heat in solid bodies. Two extremely accurate and sensitive methods of measuring the march of diffusion by measuring electromotive forces are introduced, based upon the observation that the electromotive force between two plates of zinc which are electrodes of superposed zinc sulfate solutions of different concentrations, is within moderate intervals of concentration proportional to the difference of concentration of both liquids. The disturbing influence of temperature in these phenomena is shown with great accuracy by these methods.

396. 1879. CHAPPUIS, P. Ueber die Verdichtung der Gase auf Glasoberflächen. *Wied. Ann.*, Vol. 8, p. 1–29.

The author followed the principle of Magnus of determining the amount of gas held by a glass surface, i. e. measuring the volume of gas at constant pressure evolved from a large and known surface, by exposing the latter to temperatures from 0° to 180° C. Thus values were obtained for Hydrogen, Air, CO_2, SO_2 and NH_3. Incidentally the coefficient of expansion of Ammonia gas at constant pressure was determined for the first time, for temperatures ranging from 0° to 180° C.

397. 1879. MOHR. Ueber die Natur der Cohäsion und ihre chemische Bedeutung. *Lieb. Ann.*, Vol. 196, p. 183–213.

An earnest arraignment of the atomistic theory and certain consequences drawn therefrom (such as the explanation of isomerism by presuming the existence of a difference in the concatenation of atoms within the molecule, etc.) He charges this theory with ignoring the heat phenomena in bodies, and demands the application of the law of the conservation of energy to chemical processes also. The force of Cohesion the author refers to the wave theory, and adduces numerous examples ingeniously collated to illustrate his point.

398. 1879. MOUSSON, ALB. *Die Physik auf Grundlage der Erfahrung*, 3 Vols., Zürich, 1879–1882.

Vol. I, p. 264-302, considers the Cohesion of Liquids and Capillarity.

399. 1879. MENSBRUGGHE, VAN DER. Sur le problème des liquides superposés dans un tube capillaire. *Mém. Couronn. Brux.*, Vol. 41, (1878,) No. 1. Also see *Ann. Phys. Chem. Beiblätter*, Vol. 3, (1879,) p. 772–775.

Not accessible.

400. 1879. FITZGERALD, GEO. FR. On the Tension of Vapors near curved surfaces of their liquids *Phil. Mag.*, (5) Vol. 8, p. 382–384.

The connection of Sir W. Thomson's theory of Vapor tension at curved Surfaces (see No. 319.) with the theory of Evaporation is pointed out.

401. 1879. MENSBRUGGHE, VAN DER. Du rôle de la surface libre de l'eau dans l'économie de la nature. *Assoc. Franç. Comptes Rendus*, 1879, p. 553–561.

Not accessible.

402. 1879. RAYLEIGH, LORD. On the Capillary phenomena of Jets. *Proc. Roy. Soc.*, Vol. 29, p. 71–97.

The remarkable periodic contractions taking place in a liquid jet issuing from orifices of various shapes, are dominated by capillary force, a fact recognized by H. Buff in 1857. The author calls *wave-length*, the length of the jet between two such recurring contractions. A jet of methylated alcohol has twice the wave length of water under otherwise equal conditions, which is due to the inferior capillarity of the former. A mathematical relation between wave-length, surface tension, specific gravity, cross section and pressure is established and verified by experiment. Capillarity also becomes evident in cases where a cylindrical jet issuing from a circular orifice resolves itself into globular masses, (see No. 200.)

403. 1879. RODENBECK, HERMANN. *Ueber Capillaritätsbestimmungen von Flüssigkeitsgemischen.* Dissert., Bonn. 62 pp.

If two liquids are mixed in varying proportions and if a curve is constructed by taking the specific gravities of the mixtures as abscissae, and by taking as ordinates the constants of capillarity herein defined as the square root of the specific cohesion (see No. 302,) measured at constant temperature, a striking difference will become evident between such pairs of liquids as contract, and such as do not contract in volume upon being mixed. The former class (e. g. alcohol and water,) present a non-linear curve, while the second class (e. g. Ether and Chloroform,) present a straight line. The constant of capillarity of the non-contracting mixture can be calculated from those of its constituents by a simple relation obtainable by merely applying the rules of alligation. The formula for the constant of capillarity for mixtures of contracting liquids, however, must be empirically determined for each particular pair of liquids, and was ascertained by the Author for alcohol and water.

404. 1879. MENSBRUGGHE, VAN DER. Remarques sur la mesure de la tension superficielle des liquides. *Journal de Physiaue*, Vol. 8, p. 52–57.

Not accessible.

405. 1880. NOACK, KARL. *Experimental-Untersuchungen über die Steighöhen von Wasser und Alcohol.* Dissert. Giessen, 35 pp.

The capillary heights of rise of water and alcohol at certain definite temperatures between 0° and 190° C are measured and tabulated, and an empirical formula is established, showing the variation of the Constants of Capillarity with temperature. The capillary rise of mixtures of alcohol and water is also considered. (Compare No. 403.)

406. 1880. LONG, J. H. Ueber Diffusion von Salzen in wässeriger Lösung. *Wied. Ann.*, Vol. 9, p. 613–641.

By means of a specially devised apparatus the salt solution constantly diffuses into pure water, the diffusate being carried off at a steady rate (say 80 cc per hour.) An equilibrium of diffusion does not establish itself until after the first twenty-four hours. Diffusive value increases more rapidly than does concentration. (Beilstein.) The author calculated the *relative molecular diffusion* which is the quantity of diffusion in twenty-four hours divided by molecular weight. Thus, the relative number of molecules diffused is about the same for KCy, KCl, K Br. and K I., their conductivity also being identical. Kohlrausch having found identical conductivity for HCl, H Br, H I and HNO_3, the author calculated from Graham's results, (see No. 198,) the relative molecular diffusion of each of these substances and found them also to be nearly identical. The author in this connection theorizes on the constitution of solutions, and mentions Schuhmeister's researches who concluded (1879) that Salt solutions form the same series when classified according to conductivity, inner friction and diffusibility.

407. 1880. SCHLEIERMACHER, AUG. Ueber die auf einem benetzten Körper verdichtete Flüssigkeitsmenge. *Wied. Ann.*, Vol. 8, p. 52–83.

The author does not deny that a solid dipping into a fluid may condense a liquid layer of greater density upon its surface, (see No. 114,) but pronounces the numerical value of this condensation given by Wilhelmy to be by far too high. He concludes from experiments partly similar to those of Roentgen, (see No. 385) that the influence of condensation may safely be neglected in the determination of specific gravities, if no higher degree of accuracy than 0.002 per cent. be a consideration.

408. 1880. ROGER, E. Théorie des phénomènes capillaires. Fifth memoir. *Comptes Rendus*, Vol. 90, p. 908.

By theoretical considerations a formula expressing the law of molecular attraction is established, which includes the law of gravitation as a special case. Compare subsequently De Heen. (See No. 471.)

409. 1880. HANNAY, J. B. On the State of Fluids at their Critical Temperatures. *Proc. Roy. Soc.*, Vol. XXX, (1879-80,) p. 478-484.

The author places a light gas, e. g. Hydrogen, above the liquid to be tested for its properties near its critical point, in order to enable a better observation of these phenomena, because a sharp line of demarcation remains thereby established whether the liquid be below or above its critical point, (i. e. gasified.) In the first case, slight reduction of pressure will effect boiling of the liquid, while in the second case the gasified liquid responds by merely expanding. Alcohol was observed to boil at 1° C below its critical temperature, and to expand at 1° C above, expansion took place whether the pressure was 60 or 200 atmospheres.

Again, the capillary height of a column of CS_2 becomes zero at the critical point, whether the pressure is 80 or 140 atmospheres. Thus, experimental proof is furnished of the fact that cohesion in liquids decreases upon warming and disappears altogether at the critical temperature, not being restored by increase of pressure.

410. 1880. VOLKMANN, P. Ueber den Einfluss der Krümmung der Wand auf die Capillaritätsconstante bei benetzenden Flüssigkeiten. *Wied. Ann.*, Vol. 11, p. 177.

An influence of the curvature of the wall of a glass vessel upon the constant of capillarity of a liquid with which it is in contact, as claimed by Wilhelmy (see No. 279,) does not exist, at least not to such an appreciable extent as this author believed. Wilhelmy's erroneous result may be traced to and fully explained by the erroneous assumption that the specific gravity for alcohol is 0.793° C, while it actually is 0.793 at 0° C. and 0.782 at 17.5° C.

Parallel plates and tubes of glass were used to observe and measure the capillary rise of Alcohol and "Klauenfett" which easily retain their capillary purity and therefore give constant results The author observes that when the glass is perfectly wetted by the liquid, the latter rises along a liquid layer of constant thickness, which the author has found for these liquids to be 0.004 mm.

411. 1880. LIPPMANN, GAB. Bemerkungen über einige neuere electrocapillare Versuche. *Wied. Ann.*, Vol. 11, p. 316–324.

The author reaffirms his former conclusions (see No. 373,) against experimental criticisms by L. Grätz and by Quincke, and points out that the extreme sensitiveness of his capillary electrometer (see No. 348,) and its usefulness in measuring exceedingly small electromotive forces is also recognized by other authors.

412. 1880. OBERBECK, A. Ueber die Reibung in freien Flüssigkeitsoberflächen. *Wied. Ann.*, Vol. 11, p. 634–652.

A rectangular vertical brass plate delicately suspended in the liquids to be examined was made to oscillate around its axis, first with the upper edge of the plate entirely in the liquid, then exceedingly near the surface, and thirdly slightly above the surface. If a surface friction exists, it must exert its influence upon the oscillations of the plate.

With all liquids examined, the resistance rises appreciably when the plate approaches the surface. Upon further elevation, when the upper edge falls within the liquid surface, the various liquids exhibit characteristic differences in the exact manner as described by Plateau (see No. 321,) as follows:

1. Liquids exhibiting considerable increase of resistance. Water and aqueous salt solutions.
2. Liquids exhibiting decrease of resistance. Alcohol, alcoholic solutions, carbondisulfide, oil of turpentine.
3. Mixtures of alcohol and water leaning towards one or the other group, according to their relative proportions.

413. 1880. MENSBRUGGHE, VAN DER. Voyages et métamorphoses d'une gouttelette d'eau. *Bull. Brux.*, Vol. 50, p. 423–447.

Not accessible.

414. 1880. CLARK, J. W. On the behavior of Liquids and Gases near their Critical Temperatures. *Phil. Mag.*, (5) Vol. 10, p. 145–155.

When a sealed glass tube containing a capillary tube which dips into Alcohol, Ether or Carbondisulfide, is gradually heated, the liquid sinks in the capillary and rises by expansion in the outer tube.

Within 2° or 3° C, below the critical temperatures of these liquids, both surfaces become level. When the end of the capillary tube dips but slightly below the surface of the liquid. the meniscus does not sink below the outer level as it might do otherwise, but is *level* at the moment of the disappearance of the liquid.

At temperatures very near the critical, the densities of liquid and vapor are nearly equal; when contained in closed U tubes, and the heating is one-sided, the entire disappearance of the liquid from one branch of the tube does not affect its level in the other. A detailed summary is given. (Compare No. 95, 218 and 318.)

415. 1881. WAALS, J. VAN DER. *Die Continuität des gasförmigen und flüssigen Zustandes.* Transl. and additions made by Dr. Friedr. Roth, Leipzig, 1881, 168 pp.

This celebrated treatise on the Continuity of the gaseous and liquid states of matter owes its existence to the author's desire to arrive, through theoretical considerations, at numerical values for the constant K in Laplace's theory of Capillarity, (see No. 64.) This constant represents the molecular pressure upon the unit of liquid surface hence a measure of cohesion, and was supposed by Laplace to be immensely high. For Ether the author calculates a pressure of about 1,300 atmospheres, for water 10,500 atmospheres along one millimeter's length. The author records Bosscha's experiments which prove the existence of a surface tension and the possibility of capillary phenomena even for tobacco smoke and water vapor. To this the author adds his own experience to the effect that in moistened capillary tubes, foggy vapors exhibit a meniscus and are depressed like Mercury; this phenomenon is especially striking in a capillary U tube, one limb of which is moistened while the other is dry.

416. 1881. HANNAY, J. B. On the Limit of the Liquid State. *Proc. Roy. Soc.*, Vol. XXXI, 1880–81, p. 520–522.

In this paper the phenomena of the critical temperature for CS_2, Alcohol and Methyl alcohol (see No. 391,) are studied by observing the decrease of capillary rise at increasing temperatures. The results obtained are illustrated by curves.

417. 1881. KUNDT, A. Ueber den Einfluss des Druckes auf die Oberflächenspannung an der gemeinschaftlichen Trennungsfläche von Flüssigkeiten and Gasen. *Wied. Ann.*, Vol. 12, p. 538-550.

Th. Andrews had found (*Phil. Mag.*, (5) Vol. I, p. 78, 1876,) that the critical point of a gas is lowered by the admixture of a noncondensible gas. Cailletet (*Comptes Rendus*, 1880, Vol. 90, p. 210,) liquefied a mixture of CO_2 and 1-5 air at temperatures below 26° C. When increasing the pressure to 150-200 atmospheres, the meniscus of the liquid became more and more flat and finally the liquid was "dissolved in the gas." (See Nos. 95 and 96.)

The author reasons that any ordinary liquid or solid may thus be gasified and its surface tension lowered by pressing into it a gas which is above its critical temperature; provided the pressure is immensely high. But the decrease of surface tension (the lowering of the capillary height of rise of the liquid,) can be watched within experimental limits. Pressure with air reduces surface tension more rapidly than with Hydrogen. An interesting summary of results is given.

418. 1881. WROBLEWSKI, S. VON. Ueber die Anwendung der Photometrie auf das Studium an Diffusionserscheinungen an den Flüssigkeiten. *Wied. Ann.*, Vol. 13, p. 606–623.

The process of diffusion is not only governed by the molecular velocities of both fluids, but also by molecular forces causing variable contraction. Such variation takes place for example according to whether water is in contact with a concentrated or with a dilute solution of salt. Thus the coefficient of diffusion cannot be considered a constant quantity; it assumes a special value for each case of experiment, hence the discrepancies of this value in the literature on the subject. The author especially measured the diffusion of exceedingly dilute salt solution into pure water colored by the optically permanent Nigrosin. The march of diffusion was studied by means of a spectro-photometer. The constant of diffusion in this case was found to be one-tenth of the lowest on record.

419. 1881. JOULIN, L. Recherches expérimentales sur la diffusion. *Ann. Chim. Phys.*, (5) Vol. 22, p. 398–421.

The work is summarized in 8 tables dealing with 1st, the absorption of dry gases (CO_2, N, O, NH_3, H) by charcoal at temperatures from -20° to 255° C, and pressures from a few ccm of Mercury to 4 atmospheres. 2nd the absorption of mixtures of dry gases by charcoal, and 3rd, the quantity of exchange between the gas condensed on charcoal and that of its containing vessel.

420. 1881. HOPPE-SEYLER, FELIX. *Physiologische Chemie.*, 4 Vols., Berlin, 1878–1881.

In Vol. I is contained (p. 140-148) a chapter on the Diffusion of Liquids which is a summary review of the researches of Graham (see No. 198) Beilstein, (*Ann. Chem. Pharm.*, Vol. 99, p. 165,) A. Fick, (see No. 214,) Simmler and Wild, (See No. 223,) E. Voit, (see No. 294,) and the author himself. Further chapters (p. 150-174,) are on Filtration, Transsudation, Imbibition and Osmosis.

421. 1881. HART, S. L. On some Capillo-Chemical effects. *Phil. Mag.*, (5) Vol. 12, p. 324–340.

Studied the generation of electricity under varying conditions, in a body of mercury contained in a funnel with long stem ending in a fine point; he finds that the advancing drop becomes positively charged, while the retreating end is charged negatively and becomes oxidized by prolonged action. Fanning the surface of the mercury increased the deflection, while substitution of the surrounding air by coal gas caused the deflection to be reduced to zero.

422. 1882. KŒNIG, A. Ueber die Beziehungen zwischen der galvanischen Polarisation und der Oberflächenspannung des Quecksilbers. *Wied. Ann.*, Vol. 16, p. 1–38.

A detailed list of references to the subject of the mutual relation between galvanic polarization and surface tension of mercury is given. Mercury was placed against various acid and salt solutions, etc., in a suitable apparatus which also allowed the necessary electrical measurements. The tabulated results show a maximum of surface tension for increasing values of electric potential, the maximum point varying with the different liquids.

423. 1882. WROBLEWSKI, S. VON. Sur l' influence de la quantité du gaz dissous dans un liquide sur sa tension superficielle. *Comptes Rendus*, Vol. 95, p. 284–287; also see *Phil. Mag.*, (5) Vol. 14, p. 327–328.

The author shows Kundt's interpretation (see No. 417) of the decrease of surface tension with pressure to be wrong. The decrease is merely a secondary effect. The primary cause consists in the absorption of gas by the surface layer, resulting in a decrease of surface tension with increasing quantity of dissolved gas, hence secondarily with increasing pressure. This was shown by the author with CO_2 at pressures from 1 to 30 atmospheres. In Kundt's opinion, cohesion (surface tension) would be lowered with increasing temperature, but the opposite takes place; i. e., when the pressure (above one atmosphere) remains unchanged, increase in temperature will lower saturation power for gas, hence will increase surface tension. It is shown that as solubility does not keep pace with increasing pressure, the surface tension of water saturated with CO_2 will approach a limit which at 0° is reached at the pressure required to liquefy CO_2. At this point the surface tension of the supernatant waterstratum is reduced to about one-half.

424. 1882. WROBLEWSKI, S. VON. Sur la tension superficielle de quelques liquides au contact de l'acide carbonique. *Comptes Rendus*, Vol. 95, p. 342–343; also see *Phil. Mag.*, (5) Vol. 14, p. 327–328.

When alcohol, oil of turpentine, ether or chloroform, which are liquids *miscible* with liquid carbon dioxide, are saturated under increasing pressure with the gas, the surface tension of each liquid will diminish with increasing pressure; the rate of diminution is much greater at a lower than at a higher temperature. But the surface tension, instead of stopping at a minimum (see No. 423), falls rapidly, and at 0° C, under the pressure at which CO_2 is liquefied, all the liquids mentioned, uniformly have the low surface tension of carbon dioxide.

425. 1882. PLATEAU, J. J. A little illusion. *Phil. Mag.*, (5) Vol. 13, p. 379.

Given a water surface, a capillary tube of moderate width dipping into it under an angle of about 40°, and a smaller capillary siphon attempting to remove the water from the top of the capillary tube into the surface immediately below. No water will drop from the capillary siphon, because the capillary action exerted by the curved surfaces concerned is greater than the gravity of the acting water column in the siphon.

426. 1882. VOLKMANN, P. Ueber die Molecularanziehung von Flüssigkeiten auf einander. *Wied. Ann.*, Vol. 16, p. 321–335.

In immiscible liquids, the surface tension of the common surface is less than the arithmetic means of the surface tensions of both liquids considered separately; in miscible liquids, the surface tension of the common surface is either equal to [ether-chloroform. ether-petroleum] or greater than [petroleum-chloroform, alcohol-chloroform] the arithmetic means of the individual surface tensions. For such miscible liquids as do not contract upon being mixed, the resultant surface tension (total cohesion) is expressed in terms of the tension of their common surface, the two individual surface tensions and the constituting volumes of the mixture. The correctness of the formula is verified by means of the results obtained by Quincke and Rodenbeck (see Nos. 312 and 406).

427. 1882. VOLKMANN, P. Ueber die Cohäsion von Salzlösungen. *Wied. Ann.*, Vol. 17, p. 353–370.

The solubility of salt in water is analogous to the miscibility of liquids, and an analogous formula is given (see No. 426). The "specific cohesion" of a salt solution (equivalent to the height of capillary rise in one and the same tube) decreases steadily with increasing percentage of salt, while the "real cohesion" (surface tension) increases nearly in proportion to the salt contents. Small quantities of *soluble* impurities do not materially affect cohesion or surface tension of salt solutions or even water.

428. 1883. VOLKMANN, P. Beobachtungen an fallenden Quecksilbertropfen. *Wied. Ann.*, Vol. 19, p. 66–70.

A drop of mercury, growing at the lower orifice of a vertical capillary tube, forms with the horizontal plane decreasing angles until a minimum value is reached, but does not quite attain the usual edge-angle of mercury for glass (30°–45°). Upon further growth of the drop, the angle again increases, until at 90°, according to the author, it has reached the limit of its stability. This state he calls the "largest" drop, and that immediately following the "falling" drop. The surface tension of mercury is calculated from measurements of the height of the "largest" drop, the height of the remaining drop. the diameter of the tube at the point of exit, and the weight of the falling drop.

429. 1883. ROENTGEN, W. C. Ueber einen Vorlesungsapparat zur Demonstration des Poiseuille'schen Gesetzes. *Wied. Ann.*, Vol. 20, p. 268–271.

By an ingenious contrivance tinted water is allowed to flow from a high, constant level through two consecutive capillary tubes of equal length and diameter; one vertical manometric tube being inserted before the first, another between the two capillary tubes. Under this condition, the water stands twice as high in the first as in the second manometric tube. In replacing the second capillary tube by one of half its length but of same diameter, or by one of equal length but half the diameter, the manometric pressures again adjust themselves in exact accordance with Poiseuille's law (see No. 162).

430. 1883. BUNSEN, R. Ueber die Adsorption von Kohlensäure in Glas. *Wied. Ann.*, Vol 20, p. 545–560.

Contrary to accepted opinions, Bunsen observed that great surfaces of glass (in the form of fine glass threads) absorb CO$_2$ in appreciable quantity, but slowly; the absorption is not completed in three years. Increased temperature *increases* adsorption; changes of pressure do not materially affect the phenomenon (see No. 447).

431. 1883. BASHFORTH, FRANCIS. *An attempt to test the Theories of Capillary Action by comparing the Theoretical and Measured Forms of Drops of Fluid.* Cambridge, 1883.

The calculations embodied in this painstaking work were completed in 1857. Chapters 1st and 2nd give an historical review of the theories and experimental tests of capillarity. Chapter 3rd contains the elaborate calculation of the theoretical forms of drops of fluid under the influence of capillary action. Assisted in by J. C. Adams. Chapter 4th treats of the comparison of calculated and measured forms of drops, with tables, and the appendix (completed in 1862) treats of the determination of capillary constants of mercury in contact with glass; ending with tables.

The reliability and usefulness of these tabulated data are acknowledged by recent writers on capillarity (see e. g., SIEDENTOPF, 1897).

432. 1883. LE CONTE, JOHN. Apparent Attractions and Repulsions of Small Floating Bodies. *Phil. Mag.*, (5) Vol. 15, p. 47–56.

The full history of these phenomena, as treated by various authors since Mariotte (1655), is given. The explanation is based on the following two propositions: "Both in the case of wetting and non-wetting of the solid by the liquid, an adhesion exists between solid and liquid. The capillary forces are in any given case inversely proportional to the radii of curvature of the meniscuses, and their resultants are directed toward the centers of concavity." The primary cause of the phenomena of attraction and repulsion lies in the existence of a tensile surface film, upon which the curvatures of the meniscuses act as disturbances (see No. 446).

433. 1883. RILEY, JOHN T. On Capillary Phenomena. *Phil. Mag.*, (5) Vol. 15, p. 191–198.

The molecular pressure K, due to a plane surface, which figures so prominently in the capillary theory of Laplace (see No. 71), according to the author is either non-existent or but very small. This view he supports by an experiment. The basis of all capillary phenomena is the existence of a surface tension uniform in all directions in the free surface; when in contact with a solid, its numerical value is modified by the hydrostatic elevation or depression of the liquid. The phenomena of capillary attraction and repulsion, discussed by Le Conte (see No. 432), are secondary results of surface tension, and are produced by modified hydrostatic pressures. The existence of a definite angle of contact is also a result of surface tension.

434. 1883. WORTHINGTON, A. M. On the Horizontal Motion of Floating Bodies. *Phil Mag.*, (5) Vol. 15, p. 198–208.

The horizontal motion of floating bodies (see Nos. 432 and 433) is explained by the author by taking into principal account the horizontal components of capillary forces, deducible from the principles of a definite surface tension, a definite angle of contact, and the hydrostatic pressure when the surfaces are depressed by capillarity, or hydrostatic tension when the surfaces are raised above the surrounding level.

435. 1883. STABLES, W. H., and WILSON, A. E. Experiments on the Viscosity of a Solution of Saponine. *Phil. Mag.*, (5) Vol. 15, p. 406–414.

Circular disks were allowed to swing within or a little below the surface of water and saponine solutions, and the relative resistances were noted (apparatus of Grotrian, *Pogg. Ann.*, Vol. 157, p. 237). At the surface of a 2% saponine solution, the resistance is at least 600 times greater than in the interior; the ratio is reduced to 16 times by immersing the upper surface of the disk to a depth of 0.1 mm. (compare No. 412).

436. 1883. WIEDEMANN, E. On the condensation of Fluids on Solid Bodies. *Phil. Mag.*, (5) Vol. 15, p. 440. From *Wied. Ann.*, Vol. 17 (1882), p. 988–990.

Wilhelmy's conclusions as to a condensation of liquids on solid bodies having been disproved by Roentgen, Schleiermacher and Volkmann (see Nos. 279, 385, 407 and 410), the author deduces from Van der Waals's theory on the magnitude of molecular forces (see No. 415) the weight of such a fluid layer to be less than 25×10^{-8} grammes; hence a wholly negligible quantity.

437. 1883. REINOLD, A. W., and RUECKER, A. W. On the Limiting Thickness of Liquid Films. *Phil. Trans.*, 1883, No. 174, p. 645–662.

Two completely independent methods (electrical and optical) of measuring the thickness of the black portions of a soap film (see No, 376) give concordant results. They vary between 7.2 and 14.5 millionths of a millimeter. The average value is 11.6 millionths of a millimeter.

438. 1883. KROUCHKOLL. Variation of the Constants of Capillarity of the Surfaces Water-Ether and Water-Carbondisulphide under the Action of Electromotive Force. *Jour. Chem. Soc. Abst.*, 1883, p. 1047, from *Comptes Rendus*, Vol. 96, p. 1725–1728.

The author finds that *insulating liquids*, such as carbon disulphide, ether, turpentine, acquire a distinct conductivity in contact with water, capable of being demonstrated by Lippmann's electrometer (see No. 348). Lippmann's well-known experiments with mercury can thus be repeated with ether or with carbon disulphide, although the effects are much retarded.

439. 1883. SCHIFF, R. Constant of Capillarity of Liquids at their Boiling Points. *Jour. Chem. Soc. Abst.*, 1883, p. 549, from *Ber. d. Deutsch. Chem. Ges.*, Vol. 15, p. 2965–2975.

The constant of capillarity (surface tension) for a number of organic liquids at their boiling points was determined by measuring the height of rise of the liquid in the capillary limb of the tube, the apparatus being suspended in the vapors of the same liquid at boiling temperature.

440. 1883. RAMSAY, WILLIAM. On the Critical Point of Liquefiable Gases. *Phil. Mag.*, (5) Vol. 16, p. 118–120.

The critical point of a liquid is here defined as that point at which the liquid, owing to its expansion, and its vapor, owing to compression, acquire the same specific gravity, and consequently mix with each other. The paper is a priority claim against Jamin.

441. 1883. RAYLEIGH, LORD. On Laplace's Theory of Capillarity. *Phil. Mag.*, (5) Vol. 16, p. 309–315.

Theoretical considerations on the constitution of liquids and the nature of capillary force. The author defends Laplace's assumption of the existence of an intense molecular pressure in liquids due to the plane surface (compare No. 483).

442. 1883. WORTHINGTON, A. M. On Laplace's Theory of Capillarity. *Phil. Mag.*, (5) Vol. 16, p. 339–344.

Theoretical considerations.

443. 1884. ——— ———. The Ascent of Water in Plants. Editorial in *Nature*, Vol. XXX, p. 561–562.

BOEHM ascribes the rise of water in plants to the effect of atmospheric pressure upon a system of air-bubbles and water. SACHS has brought forth his *imbibition* theory; i. e., the imbibed water molecules are held between the complex cell molecules as salt is held in sea water. ELFVING'S recent theory is based on the existence of Jamin's chapelets (see No. 242), which are permeable to water but not to air; the molecules of water can freely move without difficulty, and traveling towards the transpiration surfaces, can reach any height with the greatest ease (*step theory*, so called).

444. 1884. SCHIFF, ROBERT. Ueber die Capillaritätsconstanten der Flüssigkeiten bei ihrem Siedepunkt. *Lieb. Annal.*, Vol. 223, p. 47–106. Also see *Jour. Chem. Soc. Abst.*, 1884, p. 808.

The constant of capillarity (surface tension) of a liquid in capillary spaces is defined as the weight of the liquid suspended from the unit of length of the contact line of the meniscus. This constant is herein ascertained at the boiling point of the liquid, and the author divides its value by the molecular weight, thus obtaining a new capillary constant (= N), which expresses the relative number of molecules suspended along the above-named unit of length.

Interpreting his tabulated results, the author discovers a remarkable capillary equivalency between the atoms of C, H, O and Cl; for example, the compounds C_6H_{14}, C_8H_{10} and $C_5H_{10}O_2$ have identical N, equal to 16; hence C_2 is equivalent to H_4, C_3 equivalent to O_2. The same equivalents hold good in several other groups where N has a different value. The following equivalents are finally established $C = H_2$, $O = H_3$, $Cl = H_7$, which allows any organic formula containing C, H, O and Cl to be expressed in hydrogen equivalents. Taking the latter as abscissæ and the corresponding values for N, as found by experiment, as ordinates, a curve is constructed which permits this new constant of capillarity (relative number of raised molecules) to be deduced for any organic liquid not herein examined, from its mere chemical formula. An equation of the curve is also given. However, some interesting restrictions are indicated.

445. 1884. CHERVET, ALFRED. Distribution du Potentiel dans des masses liquides de forme déterminée. *Ann. Chim. Phys.*, (6) Vol. 1, p. 256–283.

A rectangular body of copper-sulphate solution is traversed by an electric current. A general law is theoretically deduced, expressing the potential energy existing at any point of its surface. The law was then verified by touching different points of the surface with the ends of two wires leading to a sensitive capillary electrometer of special construction. The different compensating pressures thus required to bring the meniscus back to its zero point (compare No. 348) are tabulated and compared with the values calculated from the formula.

446. 1884. LE CONTE, JOHN. Horizontal Motions of Small Floating Bodies in Relation to the Validity of the Postulates of the Theory of Capillarity. *Amer. Journal of Science*, (3) Vol. 27, p. 307–315.

The author's abnormal results in determining the height of rise of water in capillary tubes of various diameters, and between parallel plates whose distances were varied, lead him to antagonize the correctness of the fundamental postulates of the capillary theory as summarized by J. Clerk-Maxwell (see No. 374), and to favor the views expressed by Simon (see No. 202). From his tabulated results the author for example deduces that Jurin's law (see No. 16) fails to be even approximately verified when the diameter or the plate distance exceeds 0.2 cm. Surface tensions, which, according to the theory, should be a constant quantity for the same liquid at the same temperature and for all variations of diameter and height of rise and even variation of method, become approximately constant only at diameters below 0.2 cm., and decrease with increasing diameter; and the surface tension measured in tubes was to that measured with parallel plates as about ⅓ x 3.1416 : 1 (compare No. 202).

447. 1884. KAYSER, H. Ueber die Verdichtung der Kohlensäure an blanken Glasflächen. *Wied. Ann.*, Vol. 21, p. 495.

Endeavoring to account for Bunsen's abnormal results (see No. 430), the author demonstrates by diffusion experiments that CO_2 is liable to diffuse against air through a layer of fat that may be used in making ground glass stoppers gas-tight. In cases devoid of this influence. a maximum of absorption establishes itself shortly, and the gas volume then remains rigidly constant.

448. 1884. ROTHER, O. Ueber Capillaritätsbestimmungen von Salzlösungen und deren Gemischen. *Wied. Ann.*, Vol. 21, p. 576–615.

The capillary rise of water and certain salt solutions (NaCl, KCl, Na_2SO_4 and K_2SO_4) in tubes of elliptical cross section of known dimensions is measured, and the capillary constants deduced therefrom. Two sets of empirical formulæ are established, which allow calculating the two principal constants of capillarity when the concentration of these solutions and the capillary constant of water are known. Volkmann's rule, as well as that of Rodenbeck (see Nos. 426 and 408), as to the surface tension of miscible non-contracting liquids are verified on mixtures of the above salt solutions.

449. 1884. BUNSEN, R. Ueber die langsame Verdichtung der Kohlensäure an blanken Glasflächen und Kayser's Einwürfe dagegen. *Wied. Ann.*, Vol. 22, p. 145–152.

As to Kayser's explanation of the anomalous adsorption phenomena of CO_2 on glass surfaces (see No. 447), Bunsen points out that in Kayser's apparatus, which had the supposed fault to a large degree, only one-tenth of the amount of carbonic acid had disappeared that was absorbed in Bunsen's previous experiments (see No. 430). By a new series of experiments, wherein greased fittings were excluded, Bunsen was able to verify all his former, though abnormal, observations. He then proposes to study the influence of the air adhering to the glass surface.

450. 1884. QUET, M. Sur l' accord de l' expérience et de la théorie dans l' élévation de l' eau entre des plaques verticales parallèles et mouillées. *Comptes Rendus*, Vol. 90, p. 87.

On the basis of Gay Lussac's Constant of Capillarity (see No. 76), the author establishes formulæ for the capillary elevation of water between parallel vertical glass plates. Experimental measurements are then adduced to test the correctness of these formulæ.

451. 1884. GARBE, P. Sur les relations électrocapillaires. *Comptes Rendus*, Vol. 99, p. 123.

According to this author, the capillary constant of mercury, in contact with another fluid, is a maximum when the electric difference of the meniscus is *zero*, and its value is generally independent of the sign of this difference (compare No. 343).

452. 1884. KAYSER, H. Ueber die Verdichtung der Kohlensäure an Glasflächen und ihre Diffusion durch Fettschichten. *Wied. Ann.*, Vol. 23, p. 416–426.

Renewed experiments lead the author to reaffirm that adsorption is accomplished rapidly after introduction of the carbonic acid gas, if the glass was previously made gas-free. The adsorbed quantity increases with increasing pressure and decreases with increasing temperature (compare No. 480). The suggestion is offered that the slowness of adsorption in Bunsen's experiments may be due to a very gradual replacing of the occluded air by carbon dioxide gas.

453. 1884. WORTHINGTON, A. M. On the Surface Forces in Fluids. *Phil. Mag.*, (5), Vol. 18, p. 334–364.

From consideration of the elastic and thermal properties of solids, liquids and gases, the author synthetically proceeds to prove a rapid variation of density at the surface of a liquid, which causes the existence of either a tension or a pressure in the surface of liquids, exerted at the line of contact with a solid. From this principle of surface tension or pressure, linked with the well-known laws of hydrostatics, all capillary phenomena, including the horizontal motion of floating bodies (see No. 482) can be easily deduced.

454. 1885. DALE, R. S. Some Novel Phenomena of Chemical Action Attending the Efflux from a Capillary Tube. *Chem. News*, Vol. 51, p. 58–59.

A capillary siphon with its exit end bent upward transfers liquid A into liquid B, forming, when mixed, insoluble precipitates. Striking effects are thus obtained, consisting in the formation of solid tubes of precipitate, liquid A rising until it meets liquid B at the summit of the tube. Such pairs of liquids are, for example, Na_2SO_4 and $BaCl_2$, or ammonium oxalate and calcium chloride, or ammonia water and ferrous sulphate, sodium carbonate and copper sulphate, etc.

455. 1885. SCHALL, C. Attraction of Homogeneous Molecules. *Jour. Chem. Soc. Abst.*, 1885, p. 111–112, from *Ber. d. D. Chem. Ges.*, Vol. 17, p. 2555–2577.

The cohesion between the molecules of a liquid may be measured by means of adhesion plates (see No. 86). The author shows in what manner the weights necessary to detach the disk from the liquid surface at two different temperatures are a function of the two prevailing specific gravities. An analogous relation is established between the capillary heights of rise and the specific gravities at different temperatures. Water, benzene and its derivatives, form an exception to the first, and water and liquid sulphur to the second rule.

456. 1885. VOLKMANN, PAUL. Bemerkungen zu der Arbeit des Hrn. R. Schiff (see No. 444). *Lieb. Annal.*, Vol. 228, p. 96–111 (1885).

Volkmann recalculates Schiff's values, taking into account the existence of the edge angle formed by the meniscus, which was neglected by Schiff. On the whole, he agrees with the latter's conclusions.

457. 1885. SCHIFF, ROBERT. Notiz zu Hrn. Paul Volkmann's Bemerkungen. *Lieb. Annal.*, Vol. 229 (1885), p. 199–203.

Volkmann (see No. 456) having calculated the edge angle from Schiff's values for the meniscus heights, the latter states that, owing to evaporation of the liquid surfaces, the heights of the meniscuses, as observed by him, are unreliable quantities, and no reliable calculations can be based thereon. The author then reports new determinations of the constants of capillarity for benzol, furfurol, etc., at their boiling points.

458. 1885. GOLDSTEIN, M., and DAMSKI, A. Rise of Solutions in Capillary Tubes. *Jour. Chem. Soc. Abst.*, 1885, p. 115–116, from *Jour. Russ. Chem. Soc.*, Vol. 16, p. 642.

Valson's law (see No 311), according to which the capillary rise of salt solutions in one and the same tube is inversely proportional to the specific gravity, is shown to be non-existent for solutions stronger than 2 or 3-gramme molecules in one liter, and approximately correct only for weak salt solutions (0 to ⅛-gramme molecule in 1 liter). A marked regularity exists between the capillary rise of equi-molecular solutions of KCl, KI and KBr; the capillary height of rise of KBr solutions, in one and the same tube, is the arithmetic means between that for KCl and KI solutions of equal concentration (compare No. 308).

459. 1885. TRAUBE, J. Capillary Phenomena in Relation to Constitution and Molecular Weight. *Jour. Chem. Soc. Abst.*, 1885, p. 116–117, from *Ber. d. Deutsch. Chem. Ges.*, Vol. 17, (1885), p. 2294–2316.

The capillary rise of aqueous solutions of a great number of organic substances is measured. Voluminous tables are given, at once showing the difference in capillary height caused by difference in the concentration of solutions of the same substance, and comparing the capillary heights of unlike substances in solutions of the same degree of concentration. Among the more important conclusions are the following:

(1) The capillary height of the solution of an organic body decreases with increasing concentration, but not in linear measure.

(2) In a homologous series, the capillary height diminishes with increasing molecular weight.

(3) Isomeric substances in aqueous solution do not necessarily attain the same capillary height.

The capillary tube in one instance indicated the presence of formic acid, which was afterwards identified chemically; hence its possible use in chemical analysis (compare No. 272).

460. 1885. LLOYD, JOHN URI. Separation by Capillary Attraction. *Jour. Chem. Soc. Abst.*, 1885, p. 477–478, from *Chem. News*, Vol. 51, p. 51–54, and *Proc. Amer. Pharm. Asso.*, 1884, p. 410–419.

The differentiating action of filtering paper upon solutions is shown by dipping strips of blotting paper into various solutions of inorganic and certain organic salts, and of acids in water, and observing the distance to which the dissolved substance travels before being left behind by the water which passes onward. From ferric sulphate solution, pure water could thus be abstracted by means of a paper siphon of sufficient height, while on the other hand sodium chloride traveled 6 feet with the water without showing signs of separation.

461. 1885. SCHIFF, ROB. Constants of Capillarity of Liquids. *Jour. Chem. Soc. Abst.*, 1885, p. 717–721, from *Gazzetta chim. ital.*, Vol. 14, p. 368–447.

In a long series of determinations, the range of capillary equivalents (see No 444) is extended over bromine, iodine, sulphur and phosphorus, and some exceptions to the rule are recorded.

462. 1885. BARTOLI, A. Capillary Constants of Liquids and Cohesion of Solids. *Jour. Chem. Soc. Abst.*, 1885, p. 866–867, from *Gazz. chim. ital.*, Vol. 14, p. 553–562.

The author announces the law that "specific cohesion" (see No. 463), divided by the product of specific heat and specific gravity, is a practically constant quantity for liquids containing C, H, O and S, but is slightly diminished when halogens are present. Another relation is established between atomic weight, coefficient of expansion, specific gravity and cohesion.

463. 1885. TRAUBE, J. Capillary Constants of Certain Aqueous and Alcoholic Solutions. *Jour. Chem. Soc. Abst.*, 1885, p. 866, from *Jour. prakt. Chem.*, (2) Vol. 31, p. 177–219.

Continuation of former researches (see No. 459), among the results are the following:

The "specific cohesion" (height of rise in tube of 1 mm. radius) of mixtures of 2 liquids does not necessarily lie between the values shown by the component liquids, but may be lower than either. The cohesion of a saturated solution of an organic liquid (e. g., aniline) generally differs but slightly from that of the dissolved substance itself. Similarly, results are given for solutions of salts in water and dilute alcohol.

464. 1885. TRAUBE, J. Influence of Temperature on the Capillary Meniscus Angle. *Jour. Chem. Soc. Abst.*, 1885, p. 1033, from *Jour. prakt. Chem.*, (2) Vol. 31, p. 514–527.

Upholds Schiff's results against Volkmann's criticism (see No. 456). From his own researches he finds that there exists for every liquid a temperature at which its capillary meniscus is hemispherical, but it gradually flattens with increase of temperature.

465. 1885. SCHALL, C. Relation between Specific Gravity, Capillarity and Cohesion. *Jour. Chem. Soc. Abst.*, 1885, p. 1180, from *Ber. d. Deutsch. Chem. Ges.*, Vol. 18, p. 2032–2041.

The following laws are here restated (compare No. 455):

The capillary heights of rise ("specific cohesion"; see No. 466), or the weights necessary to detach adhesion plates from surfaces of the same fluid, decrease with increasing temperature in the proportion of the 8-3rd power of the prevailing specific gravities.

The corresponding surface tensions (see No. 444) decrease with increasing temperature in the proportion of the 11-3rd power of these specific gravities.

The laws are verified by making use of the values obtained by Schiff (see No. 444). Water forms an exception.

466. 1885. SCHALL, C. Beziehungen zwischen den Capillaritäts Constanten der Glieder homologer Reihen in Bezug auf das Specifische Gewicht. *Ber. d. Deutsch. Chem. Ges.*, Vol. 18, p. 2042–2052.

The law previously announced (see No. 465) for one and the same liquid at different temperatures can be extended to include different liquids belonging to certain homologous series. Thus, with the first members of the benzene and the alcohol series, the capillary rise in tubes of 1 mm. radius (*specific cohesion*) at the boiling points of these liquids is in direct proportion to the 8-3rd power of their specific gravities at these temperatures. Other homologous series, e. g., those of the fatty acids or esters, do not follow the law. The exception is probably due to coalescence of molecules, which seems to be especially the case with formic and acetic acids.

467. 1885. CHERVET, A. Note sur les constantes capillaires des solutions salines. *Comptes Rendus*, Vol. 101, p. 235.

Starting from the capillary constant and the inner cohesion of simple liquids, mathematical expressions are obtained for the mutual adhesion of immiscible, then miscible fluids, finally of solutions of salts in water.

468. 1885. BEZOLD, W. VON. Ueber eine neue Art von Cohäsionsfiguren. *Wied. Ann.*, Vol. 24, p. 27–37 and 569–593.

A drop of aniline violet or another tinting fluid, placed upon the surface of water contained in a tumbler, instantly spreads over the surface, forming radial spokes; the excess sinks to the bottom, producing some striking figures within the body of the water. These figures are very sensitive to differences in temperature; for example, to the influence of a glass of ice water placed at a distance of several decimeters. If a high column of a solution is allowed to stand quietly for some time, slight differences in temperature will induce separate currents in the different layers, the motions of which are rendered visible by this method of producing cohesion figures (compare No. 256).

469. 1885. BUNSEN, R. W. Ueber capillare Gasabsorption. *Wied. Ann.*, Vol. 24, p. 321–347.

A series of ingeniously conducted experiments lead the author to the following conclusions:

The cause of the absorption of CO_2 by glass does not lie in the attraction of glass for this gas; glass entirely deprived of *moisture* absorbs no appreciable quantity of gas. But glass readily absorbs water and holds it tenaciously under an enormous capillary pressure at temperatures as high as 470°. This aqueous layer is the medium for the adsorption of CO_2 by glass (compare Nos. 452 and 488).

470. 1885. MAGIE, W. F. Ueber Capillaritäts-Constanten. *Wied. Ann.*, Vol. 25, p. 421–437.

A new method, suggested to the author by Prof. Helmholtz, for calculating surface tensions from a formula given by Poisson (see No. 117). It merely requires the measurement of the radius of curvature of the meniscus; if the latter is selected small enough to be hemispherical, the radius can be measured by applying the laws of mirror reflection. The author thus determined the surface tension of mercury, which he finds approximating the values of Desains (see No. 205) and others, although much lower than that found by Quincke (see No. 284; also see J. STÖCKLE, 1898). By the same method he determined the surface tension of alcohol, distilled water, chloroform, etc., comparing the results in tabulated form with those arrived at for the same liquids by Quincke (see No. 812).

471. 1885. HEEN, P. DE. Premier Essai de Théorie des Liquides. *Ann. Chim. Phys.*, (6) Vol. 5 (1885), p. 88–120.

The gaseous, liquid and solid states of matter are characterized by gazogenic, liquidogenic and solidogenic molecules. For liquids a general relation is established between volume, temperature, coefficient of dilatation and molecular distance. The calculation of critical temperature, Gay Lussac's law of the dilatation of gases with temperature, and Mendeleef's law for fluids, are special cases of this general law. The hypothesis is advanced and verified that liquidogenic molecules attract each other in the inverse ratio of the 7th power of their distances (compare No. 408). Taking now into account the surface tension of liquids, relations are established between surface tension, temperature, and the coefficient of inner and of surface dilatation.

472. 1885. WORTHINGTON, A. M. A Capillary Multiplier. *Phil. Mag.*, (5) Vol. 19, p. 43–46.

The lower surface of a platinum coil, the convolutions of which are kept about 2 mm. apart by interposed glass beads, forms an accurate plane. This instrument measures the surface tension of a liquid as follows:

It is suspended from one arm of a balance and tared; its lower horizontal surface is then allowed to touch the liquid, which at once rises to a definite height within the convolutions. The weight necessary to detach the instrument from the liquid, divided by the total length of the contact line of the meniscus, measures the surface tension (compare L. Wilhelmy No. 278).

473. 1885. WORTHINGTON, A. M. Note on a Point in the Theory of Pendent Drops. *Phil. Mag.*, (5) Vol. 19, p. 46–48.

The capillary constant (surface tension) of liquids may be calculated quite accurately by measuring certain elements of the contour of a drop pendent from a circular base. This the author has shown in a previous paper (*Proc. Roy. Soc.*, 1881, No. 214). A more favorable mode of measurement is now introduced, which simplifies the formula containing an expression for the surface tension.

474. 1885. WORTHINGTON, A. M. On the Error Involved in Professor Quincke's Method of Calculating Surface Tensions from the Dimensions of Flat Drops and Bubbles. *Phil. Mag.*, (5) Vol. 20, p. 51–66.

Quincke's method of measuring the constant of capillarity (specific cohesion) by measuring the dimensions of flat drops or bubbles (see No. 804), gives results always higher than those from capillary tubes. The former method he believes to give the correct results, provided the drops or bubbles are selected sufficiently large that their top can be considered as flat and their extension as practically infinite. The author, however, shows that by not omitting the curvature on top of even large drops, and their finiteness, Quincke's results, recalculated, agree well with those from capillary tubes for the same substances; otherwise the discrepancy may reach 10 per cent.

475. 1885. LUVINI. The Spheroidal State of Liquids. *Nature*, Vol. 32, p. 635.

In order to test the supposition that liquids in the spheroidal state (see No. 28) do not boil because they have lost their dissolved air, air was blown into the drop while being heated. Persistent bubbles, often larger than the liquid mass, arose, sharing the movements of the drop, but sometimes they moved independently. Such bubbles were obtainable with pure and soapy water, alcohol and ether. The inference is that liquids in that state do not appreciably lose their dissolved air.

476. 1885. TAIT, P. G. *Properties of Matter*. Edinburgh, 1885.

One chapter of this book is devoted to capillarity

477. 1886. QUINCKE, G. Ueber die Bestimmung der Capillarität Constanten von Flüssigkeiten. *Wied. Ann.*, Vol. 27, p. 219–228.

The cause of the discrepancy between Quincke's capillary constants of mercury, water and salt solutions, and those of other observers, is due, according to Quincke, to the reality of an edge-angle. which was assumed to be zero by Volkmann, Worthington, Magie, etc. (see Nos. 410 and 470). For glass and water or aqueous salt solutions, the angle is from 20° to 30°.

478. 1886. EÖTVÖS, R. Ueber den Zusammenhang der Oberflächenspannung der Flüssigkeiten mit ihrem Molecular-Volumen. *Wied. Ann.*, Vol. 27, 448–459.

The author since 1875 has employed optical reflection from capillary surfaces for the determination of the constant of capillarity of liquids. The method is applicable even to liquids contained in sealed glass tubes; hence the method allows measurements at temperatures far above the boiling points of these liquids. A simple relation between molecular volume, temperature and surface tension is deduced and verified from data supplied by the author's method and Schiff's experiments (see No. 444).

479. 1886. WEINSTEIN, B. Untersuchungen über Capillarität. *Wied. Ann.*, Vol. 27, p. 544–584.

Theoretical treatment of capillary constants by Gauss's method, based on the Young-Laplace theory (see Nos. 63 and 115).

480. 1886. VOLKMANN, P. Notiz zu Hrn. G. Quincke's Bemerkungen "Ueber die Bestimmung der Capillarconstanten von Flüssigkeiten." *Wied. Ann.*, Vol. 28, p. 135–144.

Volkmann insists on the fact that he has avoided finite edge angles in his researches by insuring perfect wetting of the solid by the liquid. He points out that on this account his results were uniform.

481. 1886. NOACK, KARL. Ueber die Fluidität der absoluten und verdünnten Essigsäure. *Wied. Ann.*, Vol. 28, p. 666–684.

Continuation of a preceding paper on the influence of temperature and concentration upon the fluidity of liquid mixtures (*Wied. Ann.*, 1886, Vol. 27, p. 289–300). The author illustrates by diagrams the linear increase of fluidity with temperature for acetic acid of different concentrations, and shows decrease of fluidity with increasing concentration until a minimum is reached at 77% irrespective of temperature, this minimum corresponding to the formula $C_2H_4O_2 + H_2O$ (compare Graham, No. 254). Further increase of concentration again increases fluidity.

482. 1886. FUCHS, KARL. Ueber den Randwinkel einander berührenden Flüssigkeiten. *Wied. Ann.*, Vol. 29, p. 140–152.

For two liquids in mutual contact, several equations are established expressing relations between the work of surface alteration (work of cohesion and adhesion), tension of common surface and edge angle. The latter was recognized to be theoretically constant and independent of the radii of curvature of the liquids. It solely depends on the molecular forces existing in the two liquids.

483. 1886. BUNSEN, R. Zersetzung des Glases durch Kohlensäure enthaltende capillare Wasserschichten. *Wied. Ann.*, Vol. 29, p. 161–165.

The glass threads used by the author in his absorption experiments (see No. 469) were found to be decomposed by CO_2 to the extent of 5.88 %. Part of the CO_2 formerly evolved upon warming was, no doubt, due to decomposition of bicarbonate formed, but an additional amount must have been due to other causes.

The author concludes that glass is not a proper material for the study of physical absorption of CO_2; the employment of fine threads of platinum or gold is suggested.

484. 1886. ROENTGEN, W. C., and SCHNEIDER, J. Ueber Compressibilität und Oberflächenspannung von Flüssigkeiten. *Wied. Ann.*, Vol. 29, p. 165–218.

The authors prepared aqueous solutions of iodides, bromides, chlorides, nitrates, hydroxides, sulphates and carbonates of hydrogen, ammonium, lithium, potassium and sodium of equimolecular strength. Then they determined the compressibilities and the surface tensions of these solutions. From the elaborate tables thus obtained, the following conclusion is drawn: Within each group (e. g., HNO_3, HBr, HOH, H_2SO_4, or LiI, $LiNO_3$, etc.) the liquid with the smaller molecular compressibility has the greater surface tension.

485. 1886. STEFAN, J. Relation between the Theories of Capillarity and Evaporation. *Jour. Chem. Soc. Abst.*, 1887, p. 323, from *Wied. Ann.*, Vol. 29, p. 655–665.

A relation is established between the latent heat of evaporation, the specific gravity of the liquid, and the difference of molecular pressure existing in the interior and the surface of the liquid. For ether, the author finds the enormous interior pressure of 2574 atmospheres, for CS_2 he finds 2728 atmospheres. Sir W. Thomson's conclusions as to the connection between evaporation and curvature of evaporating surfaces (see No. 319) are herein confirmed.

486. 1886. DUHEM, P. Application of Thermodynamics to Capillary Phenomena. *Phil. Mag.*, (5) Vol. 22, p. 230–231.

General equations are established on thermodynamical principles, which bring the theory of Thomson (see No. 319) into agreement with those of Laplace and Gauss (see Nos. 64 and 115). The equations are then applied to the two special processes of evaporation and supersaturation.

487. 1886. THOMSON, SIR WILLIAM. Capillary Attraction. A Lecture before the Royal Institution. *Nature*, Vol. 34, p. 270–272, 290–294, 366–369.

Starts out by illustrating the immense force of cohesion between two plane water surfaces in immediate contact; capillary elevation is deduced therefrom on the principle of equal work performed. This leads to the demonstration of the principle of surface tension in simple liquids and the tension of the common surface of immiscible and miscible liquids. Finally, some experimental illustrations of capillary phenomena are given, e. g., the capillary behavior of mercury; the form and properties of drops, the displacement of a liquid of strong surface tension (water) by one of less surface tension (alcohol), for which the "tears of strong wine" are an example (see No. 218).

488. 1886. MAGIE, W. F. Note on a Method of Measuring the Surface Tension of Liquids. *Amer. Jour. Science*, Vol. 131, p. 189–193.

The principle of the method by means of which the author proposed to decide the question of the existence of a contact angle is stated under No. 510. The results herein obtained still leave the question open.

489. 1886. TRAUBE, J. Ueber die innere Reibungsconstante und die specifische Zähigkeit organischer Flüssigkeiten und ihrer wässrigen Lösungen. *Ber. d. Deutsch. Chem. Ges.*, Vol. 19, p. 871–892.

The apparatus employed by the author to determine the constant of the inner friction of liquids passing through capillary tubes, by Poiseuille-Hagenbach's method (see Nos. 162 and 246), also allows measurements of the weight of falling drops, therefore of capillary constants. The friction constants for a series of alcohols and of organic acids were determined at temperatures between 20° and 60°, and the results illustrated by diagrams in which were included the results of PAGLIANI and BATTELLI (Turin, 1885), for the same liquids at temperatures between 0° and 10° (compare No. 254). The volumes of the drops are proportional to the heights of rise of the liquids in capillary tubes. A further consequence is the rule that the dropping intervals are proportional to the products of friction constants and dropping volumes or capillary rise.

490. 1886. TRAUBE, J. Methode zur Bestimmung des Fuselöls. *Ber. d. Deutsch. Chem. Ges.*, Vol. 19, p. 892–895.

Since aqueous solutions of high-molecular alcohols have a markedly lower capillary rise than corresponding solutions of ethyl alcohol, the presence of fusel oil in diluted spirits may be expected to be recognized by the decrease of capillary rise. The apparatus used by the author was previously described (*Journal f. prakt. Chem.*, 1886, p. 177). A table is given, showing the decrease of capillary rise of a 20 % spirits containing fusel oil of varying percentages (0 to 1 %) (compare No. 505).

491. 1886. TRAUBE, J. Ueber die Grösse der Maximaltropfen der gewöhnlichen Alcohole und Fettsäuren, und ihrer wässrigen Lösungen. *Ber. d. Deutsch. Chem. Ges.*, Vol. 19, p. 1673–1679.

The law previously stated (see No 489) that the volumes of drops issuing from the lower circular end of a capillary tube are in exact ratio to the capillary heights of rise, does not hold good for very large terminal surfaces of the tube, because the drop size for increasing surfaces attains a maximum. This maximal drop, in other words, is the drop falling from a large horizontal surface. It is a constant, varying only with the cohesion of the fluids. The weight of one drop was determined by counting the drops yielded by a known volume of fluid, and multiplying by the specific gravity. An elaborate table is given, showing the maximal-drop size for alcohols and fatty acids at different temperatures It confirms the natural supposition that the maximal diameter of these drops increases with increasing cohesion.

492. 1886. TRAUBE, J. Ueber die Abhängigkeit der Tropfengrösse von äusseren Einflüssen. *Ber. d. Deutsch. Chem. Ges.*, Vol. 19, p. 1679–1682.

The influence of various conditions upon the size of drops has been exhaustively treated by Guthrie (see No. 276), and is confirmed by the author, especially as to effect of curvature of wall and velocity of flow. Contrary to Guthrie, however, the author is unable to detect an appreciable influence of the material of the wall upon the size and weight of drops; the deviations observed come within the scope of errors of observation. The author finally reiterates a former statement, to the effect that the edge-angle of one and the same liquid against glass and metal is nearly the same, and different from zero.

493. 1886. TRAUBE, J., and BODLÄNDER, G. Ueber die Unterscheidung von Eiweisskörpern, Leim und Peptonen durch Capillarität. *Ber. d. Deutsch. Chem. Ges.*, Vol. 19, p. 1871–1876.

Musculus (see No. 272) classes albumin among the capillary inactive substances. i. e., that do not appreciably reduce the capillary rise of water. This property of albumen of various sources is verified by the authors. Gelatine behaves similarly, but peptones, e. g., those contained in Liebig's extract of beef, are active to a remarkable degree. Their presence in aqueous solutions causes a marked decrease of their capillary rise, respectively decrease of the volume of drops issuing from a vertical capillary tube (see No. 491); in other words, an increase in the number of drops yielded by a given volume of peptonated solutions.

494. 1886. REINOLD, A. W., and RUECKER, A. W. On the Relation between the Thickness and the Surface Tension of Liquid Films. *Phil. Trans.*, 1886, Vol. 177, p. 627–684.

Contrary to the conclusions of previous observers, the surface tension of a soap film remains constant regardless of its thickness, a fact established over a wide range of thicknesses (12 to 1350 micromillimeters). The cause of the sudden discontinuity of the black film (see No. 376) at its edge is still in doubt; its thickness varies only between narrow limits, 7 to 14 micromillimeters, which remains fairly constant soon after its formation. The boundary line of a black film becomes ill defined when an electric current of sufficient intensity is passed through it, but is restored upon cessation of the current.

495. 1886. TRAUBE, J, Capillary Constants and Meniscus Angle. *Journ. Chem. Soc. Abst.*, 1887, p. 101, from *Journ. prakt. Chem.*, [2] Vol. 34, p. 292–311.

Values are obtained for the "specific cohesion" (theoretically the height of capillary rise in tubes of 1 mm. radius, the edge-angle being zero) for fatty alcohols and fatty acids at various degrees of concentration; both propyl and isopropyl alcohol show a minimum for mixtures of equal weights of the alcohol and water. Another series of determinations with the same fluids was made by measurements of falling drops of these fluids. The volume of the drops was found proportional to the capillary rise in one and the same tube; accordingly, the weight of the drops was found proportional to the product of the height and the specific gravity. The diameter of the tube determines the shape of the drop.

496. 1886. TRAUBE, J. The Weight of Drops, and their Relation to the Constants of Capillarity and the Capillary Meniscus Angle. *Jour. Chem. Soc. Abst.*, 1887, p. 210–211, from *Jour. prakt. Chem.*, (2) Vol. 34, p. 515–538.

For water and solutions of alcohol of different strengths, the weights of drops and their capillary constants decrease with the increasing curvature of the surface of formation of the drops. This decrease, however, does not begin before a certain degree of curvature, which is different for different liquids, neither is this decrease proportional to the increase in curvature; it appears to be the greater, the smaller the capillary constant of the liquid. He also finds the edge angle of the meniscus of drops of different liquids to be equal or proportional to the meniscus angle of the same liquid in capillary tubes. Further properties of the meniscus of drops are developed.

497. 1887. HELMHOLTZ, H. VON. A Cohesion Experiment. *Nature*, Vol. 35, p. 456.

If distilled water is placed above a mercury column in a barometric glass tube longer than 760 mm., the cohesion of the water will, provided that no vibrations occur, prevent the mercury column from falling to its barometric height, even if at the lower end a suction is applied down to 1 mm. vacuum. By means of this contrivance the minimum voltage necessary to electrolyse pure water was ascertained. This minimum occurred at 2.18 volts.

498. 1887. DUFOUR, PROF. Surface Tension and Magnetism. *Nature*, June, 1887, p. 209.

The influence of a strong magnetic field upon the surface tension of mercury is shown. A jet of mercury issuing from a horizontal capillary tube describes a parabola, the vein being continuous to a certain distance. When allowing a strong electro-magnet to act on the jet, the parabola is stretched, and the continuous part of the vein lengthens.

499. 1887. LENARD, PHILIPP. Ueber die Schwingungen fallender Tropfen. *Wied. Ann.*, Vol. 30, p. 209–243.

The surface tensions (see No. 444) of water, soap solution, alcohol and mercury, were deduced from measurements of the weights and the vibrations of falling drops of these liquids, observed by the method of intermittent photography. The surface tension of mercury was found to be 47.10 mg.-mm., for alcohol 2.50, for water from 7.25 to 7.34, these determinations being free from the assumption of an edge angle.

500. 1887. TIMBERG, GUSTAF. Untersuchungen über den Einfluss der Temperatur auf die Capillaritätsconstanten einiger Flüssigkeiten. *Wied. Ann.*, Vol. 30, p. 545–561.

A review of the literature on the influence of temperature upon the constants of capillarity of liquids is given. New experiments are carried out by means of three different methods; viz., the measurement of flat air bubbles in various liquids, the method of adhesion rings and the measurement of the weight of drops (see Nos. 370 and 276). Tables are given, and the results illustrated by curves which nearly all are sloping straight lines. Ether is the liquid whose capillary constants change fastest with temperature; then follow benzol, alcohol, water and salt solutions.

501. 1887. MELDE, F. Ueber einige Anwendungen enger Glasröhren. *Wied. Ann.*, Vol. 32, p. 659–670.

Describes a simple method for calibrating capillary tubes of 2-mm. inner width and downward. Shows how Boyle's law for gases can be demonstrated by means of a capillary tube closed at one end and containing a measurable volume of air separated from the outer air by a column of mercury. Measurements are taken with the tube first in the upright, and next in the inverted position. The same device can be used to calculate barometric pressure; hence it is called a *capillary barometer*. Finally, the author shows how capillary tubes can be used to measure the specific gravity of gases by measuring their different velocities (see No. 130).

502. 1887. COLEMAN, J. J. On Liquid Diffusion. *Phil. Mag.*, (5) Vol. 23, p. 1–10.

Graham's experiments (see No. 253) on "jar diffusion" are herein extended over additional salt solutions. The diffusions were conducted in Mohr burettes; the diffusates, in due time, were drawn off fractionally and analyzed. Curves are given which illustrate the heights of diffusion for decreasing percentages. The march of diffusibilities for different salts is analogous to that of atomic and molecular volumes in Mendeleef's arrangement of elements.

503. 1887. SUTHERLAND, W. On the Law of Molecular Force. *Phil. Mag.*, (5) Vol. 21, p. 113–114 and 168–187.

The author generalizes his previously announced molecular law for gases of the inverse 4th power as follows: Any two molecules of matter attract one another with a force proportional directly to the product of their masses, and inversely to the 4th power of the distance between them; the "molic" (astronomic) force acts in the inverse 2nd power. On this basis, the capillary theories of Laplace and Gauss are critically reviewed.

504. 1887. SIEG, E. *Ueber die Bestimmung von Capillaritätsconstanten an Tropfen und Blasen.* Dissert., 1887; also see *Nature*, Vol. 37 (1887), p. 167–168.

Quoted in detail by Lohnstein (see No. 552). The author critically reviews Quincke's measurements of capillary constants by the method of flat drops and bubbles, in order to account for the high results obtained by that method. He concludes that in Quincke's measurements the possible error of observation is quite large, and, additionally, the correction formula employed by Quincke is considered insufficient. In measurements of his own with air-free water by Quincke's method simplified, the author finds a lower value for the surface tension, more in accord with that of other observers except Quincke.

505. 1888. ELSWORTHY, H. S. Note on a Modification of Traube's "Capillarimeter." *Jour. Chem. Soc. Trans.*, 1888, p. 102–104.

Traube's "capillarimeter," devised to detect the presence of fusel oil in distilled spirits (see *Zeitschrift f. Spiritusindustrie*, 1886, No. 86), is modified for the purpose of rendering the instrument more sensitive. This is done by fixing the capillary tube in an *inclined* position. A 20-% spirits (by volume) then rises to a length of 175 mm. against 50 mm. in Traube's instrument. The presence of 1-% fusel oil reduces this height by 25 mm. against 7 mm. in Traube's prototype. A drawback of the method is the probable necessity of reducing the spirit to 20 % by volume, which reduces still further an eventual low percentage of fusel oil.

506. 1888. RUECKER, A. W. On the Range of Molecular Forces. *Jour. Chem. Soc. Trans.*, 1888, p. 222-262.

A full and interesting history of the researches on this subject, and a summary of results is recorded.

507. 1888. GOLDSTEIN, M. Rise of Salt Solutions in Capillary Tubes. *Jour. Chem. Soc. Abst.*, 1889, p. 205, from *Jour. Russ. Chem. Soc.*, 1888, Vol. 20, p. 408-415.

An extension of former researches (see No. 458). With concentrated salt solutions of equal percentage, the solution of less molecular weight has the higher capillary rise. Inversely, with solutions of equal capillary height, the solution of less percentage has the higher molecular weight. The difference of capillary heights corresponding to a difference of percentage of salt solution becomes greater for the same difference of percentage of another salt of greater molecular weight.

508. 1888. GOPPELSROEDER, F. On Capillary Analysis. *Phil. Mag.*, (5) Vol. 25, p. 244.

The basis of this method was laid by the researches of Schönbein; also see the author's former work (see Nos. 259 and 271). Coloring matters in not too concentrated solution may be differentiated by means of filtering paper; the zones, attained after a certain interval of time, are noted, and the zones separately extracted by suitable solvents. Each extract is then examined in a similar manner until zones of the pure coloring matters are obtained. Thus the author found picric acid in sophisticated beer, fuchsine in wine.

509. 1888. BOYS, C. V. Experiments with Soap Bubbles. *Phil. Mag.*, (5) Vol. 25, p. 409-419.

Two soap bubbles may be pressed together, or even roughly knocked together, without bursting, owing to a film of air between them which they are unable to exclude. Increased pressure, however, destroys the bubbles. The existence of this air film is demonstrated by a series of beautiful lecture experiments on soad bubbles.

510. 1888. MAGIE, W. F. On the Contact Angle between Liquids and Solids. *Phil. Mag.*, (5), Vol. 26, p. 162-183.

In order to decide the much-debated question of the existence of an edge-angle (see Nos. 477 and 480), the author determines a^2, the "specific cohesion" for several liquids each by two different methods, both based upon measuring certain dimensions of air bubbles in these liquids under a horizontal glass plate (see No. 512). One of these methods is independent of the assumption of an edge angle; the other takes the edge angle into account; if this angle is really zero, both values ought to be identical. The author finds the angle zero for methyl and ethyl alcohol, formic acid, chloroform and benzin, the close agreement thus showing the usefulness of the method. The angle is finite for water (though small), for acetic acid (20°), turpentine (17°), petroleum (26°) and ether (16°). The author conjectures as to the cause of this contact angle.

511. 1888. VAUTIER, TH. Recherches expérimentales sur la vitesse d' écoulement des liquides par un orifice à mince paroi. *Ann. Chim. Phys.*, (6) Vol. 15, p. 289-375 and p. 433-497.

The first of these two elaborate papers proves that Torricelli's law for the velocity of flow of liquids through an orifice at the bottom of the containing vessel holds good also for low pressures and narrow orifices, a case for which the law hitherto had not been tested. The author employs two different methods of measuring the velocity of a jet of water—one an optical, the other a photographic method, both of which are described in minute detail. Furthermore, Poiseuille's law of the inner friction of fluids passing through capillary tubes, is verified (see No. 162). The second paper deals with the application of the photographic method to the study of the flow of *viscous* liquids through capillary tubes.

512. 1888. QUINCKE, G. Ueber die physikalischen Eigenschaften dünner fester Lamellen. *Wied. Ann.*, Vol. 35, p. 561-580; also see *Phil. Mag.*, Vol. 27 (1889), p. 79-80.

The surface of contact between liquids and thin solid films seeks to be a minimum, as is the case between two liquids or liquid and gas; only in the latter cases, spheres or bubbles result, while in the former case the thin solid forms plaited films, sometimes cylindrical surfaces, owing to the inability of the solid to contract laterally. Such solid laminæ were obtained by allowing albumen, or aqueous solutions of glue, etc., to dry on mercury which was previously covered with a trace of fat. The periphery of the dried film is vertically wavy and connected with the center by radial ridges. Such solid films of isinglass, gelatin and agar-agar show double refraction of light. Other interesting properties are recorded.

513. 1888. QUINCKE, G. Ueber periodische Ausbreitung an Flüssigkeitsoberflächen und dadurch hervorgerufene Bewegungserscheinungen. *Wied. Ann.*, Vol. 35, p. 580–642.

The expansion of a liquid 3 over the common surface of liquids 2 and 1 depends on the relative magnitude of the constants of capillarity (surface tensions) of their common surfaces. If the surface tension between 1 and 2 exceeds the sum of the tensions 1, 3 and 2, 3, the excess of this tension 1, 2 draws fluid 3 over the common surface 1, 2. On this principle the author discusses the formation and the stability of emulsions and foam, and the expansion of soap solutions, etc., at the common surface of oil and water, or the formation of a mercurial emulsion by shaking together mercury, water and olive oil. Other interesting topics herein considered are: The periodical expansion of oil and water; the periodic motions of resinous bodies precipitating from alcoholic solutions, and motion phenomena of physiological nature, e. g., protoplasmic motion, the formation of solid albumen at the common surface of fatty oils and water, etc.

514. 1889. MARKOWNIKOFF. On a Method of Avoiding "Bumping" in Distillation. *Amer. Jour. Science*, Vol. 137, p. 222, from *Jour. Chem. Soc. Russ.*, 1887, p. 520, and *J. Chem. Soc. Abst.*, 1888, p. 1155.

Thin capillary glass tubes, 3 to 10 mm. in length, sealed at one end, are thrown into the liquid to be boiled. "Bumping" is effectively avoided, even with NaOH solutions and with concentrated acids, or in the presence of finely divided heavy precipitates such as $BaSO_4$.

515. 1889. SUTHERLAND, W. On the Law of Molecular Force. *Phil. Mag.*, (5) Vol. 27, p. 305–321.

The law of Eötvös (see No. 478) is stated as follows: "The rate of variation with temperature of the product of surface tension and the two-thirds power [the surface] of the molecular domain is the same for nearly all liquids." To this law, and Schiff's discovery of capillary molecular equivalents (see No. 444), the author applies his own hypothesis of the inverse 4th power of molecular force (see No. 508), and arrives at interesting results, for which see the original.

516. 1889. MENSBRUGGHE, VAN DER. Sur les propriétés physiques de la couche superficielle libre d'un liquide et de la couche de contact d'un liquide et d'un solide. 2nd part. *Comptes Rendus*, Vol. 109, p. 607.

In conformity with Gauss's theory (see No. 115), the author advocates the existence of an extending, not contractile, force as accepted by Quincke (see No. 512) at the common surface of solids and wetting liquids. He gives simple examples to uphold his views (continuation of No. 365).

517. 1889. KRAUSE, H. Ueber Adsorption und Condensation von Kohlensäure an blanken Glasflächen. *Wied. Ann.*, Vol. 36, p. 923–936.

In the absence of moisture, no condensation of CO_2 on glass takes place, whether the latter contains free alkali or not. The admission of moisture to the surface of perfectly dried glass threads is followed immediately by rapid condensation of CO_2; more of the latter condenses on glass richer in alkali than on glass containing less or none. The glass threads containing more alkali retain water more tenaciously at higher temperatures than threads that have previously been boiled out with water (compare No. 483).

518. 1889. THOMSON, SIR WILLIAM. *Popular Lectures and Addresses.* In 3 volumes. Vol. I. London, 1889.

Among the topics considered in this volume are: Constitution of Matter: Capillary Attraction, 1886; the Size of Atoms, 1883, etc.

519. 1890. GOSSART, E. Mesure des tensions superficielles dans les liquides en caléfaction (Méthode des larges gouttes). *Ann. Chim. Phys.*, (6) Vol. 19, p. 173–265.

The spheroidal state of liquids (*liquides en caléfaction*) is a particular case of capillary phenomena. The form and dimensions of the drop on the hot plate are determined by the surface tension along the liquid membrane enveloping the drop and the specific gravity of the inner liquid. The surface tension of liquids near their boiling points may thus be determined by measuring the greatest thickness of large elongated drops. Including examinations by other observers, the results of 80 liquids are tabulated. From the thickness of the drops, the surface tension of liquids near their boiling points is calculated, and the coefficients of average decrease of surface tension with temperature is deduced. Incidentally it was observed that the first five alcohols have at all temperatures about the same surface tension; the same is the case with the ethyl esters of the fatty acids.

520. 1890. GOLDSTEIN, M. Rise of Solutions in Capillary Tubes and the general law of this phenomenon. *Jour. Chem. Soc. Abst.*, 1890, p. 684. From *Zeitschr, phys. Chem.*, Vol. 5, p. 233–241. Also see *Amer. Jour. Science*, Vol. 141 (1891), p. 64–65.

A distinct relation exists between the molecular mass of dissolved salts and the capillary height of rise of the solution. (See No. 507.) The author finds the laws of capillary rise to be analogous to that of vapor pressures, and a formula is given connecting the height of rise of water, of salt solution, molecular weight and percentage of solution. The law is extended so as to include Van't Hoff's coefficient *i* for electrolytes, uniform results being obtained.

521. 1890. RAYLEIGH, LORD. On the Tension of Recently Formed Liquid Surfaces. *Nature*, Vol. 41, p. 566–568.

The author supports Marangoni's conclusions (see No. 326) that the surface tensions of soap solutions as determined by capillary tubes are independent of the strength, and that the difference in the surface tension of vertical soap films at different levels is due to the existence of a surface pellicle of lower surface tension. The author shows that when measured by means of the author's quick method of jets (see No. 402) the surface tensions of water and solutions of oleate of soda of varying strength are not reduced, while the slower method of capillary rise at once shows decrease of rise to one-third when passing from water to oleate solutions of different strengths.

522. 1890. MAXWELL, JAMES CLERK. *The Scientific Papers of J. C. M.*, by W. D. Niven, 2 Vols. Cambridge, 1890.

In Vol. II., p. 541–591, is contained reprint of article in Encyclopedia Britannica. (See No. 374.)

523. 1890. RAYLEIGH, LORD. On the Theory of Surface Forces. *Phil. Mag.* (5), Vol. 30, p. 284–298 and 456–475.

Discussing the theories of Laplace, Thomas Young and Gauss (see Nos. 63, 64, 115), the author upholds the view of an enormous molecular or "intrinsic" pressure in liquids (Laplace's Constant K.) It is probably analogous to the force necessary to break a solid. Young calculated it to be about 23,000 atmospheres (compare No. 415.) Berthelot (1850) showed that water was capable of sustaining a tension of 50 atmospheres. Theoretical calculations of the inner pressure of fluid masses are given, and different capillary problems are discussed, e. g., the tension of the common surface of liquids, the edge angle, etc. The author points out the generally unknown fact that Thomas Young (*Works*, Vol. I, pp. 461) has already estimated the limits of cohesion and the range of molecular forces.

524. 1890. RAYLEIGH, LORD. On the Tension of Water Surfaces, Clean, and Contaminated, Investigated by the Method of Ripples. *Phil. Mag.* (5), Vol. 30, p. 386–400.

The object of this paper was to determine the ratio of surface tensions between pure water and a water surface contaminated with fat to just that degree where motions of camphor on its surface are no longer visible. The method is that of measuring the wave-length of ripples. (See No. 527.) The surface tension of water contaminated to the point stated was 72% of that of pure water. The same surface tension is found for water saturated with camphor; if saturated with olive oil, the tension is 54%; with sodium oleate, 34%.

525. 1890. BECHHOLD, J. Chemical Energy at the Surface of Liquids. *Jour. Chem. Soc. Abst.*, 1890, p. 828; from *Zschr. phys. Chem.*, Vol. 5, p. 68.

The observation of W. Spring (*Zschr. phys. Chem.*, Vol. 4, pp. 658–662), to the effect that a prism of calcspar dipping to half its length into dilute hydrochloric acid is cut in two by the solvent action at the surface of the acid, is shown by the author not to be due to a specific surface action of the liquid, as was supposed by Spring; since the same phenomenon takes place when the upper half of the crystal is coated with wax and nearly the whole crystal immersed into the liquid.

526. 1890. RAYLEIGH, LORD. On the Superficial Viscosity of Water. *Nature*, Vol. 42, p. 282–287.

The author confirms Plateau's observation (compare No. 412), that the surface viscosity of ordinary water is nearly twice as great as the interior viscosity, but proves that this is due to contamination of the water surface. If a gentle stream of air be directed vertically downward upon a water surface dusted over with fine powder, a clear circle is formed around the point of impact. On the cessation of the current the dust returns. The purified surface showed a slightly less viscosity than the interior. The question arises: To what thickness must the original film be concentrated to check the motions of camphor on water? (Compare Nos. 40 and 524.)

527. 1890. SMITH, MICHIE. Determination of the Surface Tension of Mercury by the Method of Ripples. *Nature*, Vol. 44, p. 575;

Ripples are generated on the mercurial surface by means of a tuning fork (see No. 664), and the surface is photographed along with a suitable scale. The lengths of the ripples can thus be conveniently measured. The results are concordant and agree with the mean value of Quincke. A few measurements of the surface tension of water also give concordant results.

528. 1890. BOYS, C. V. *Lectures on Soap Bubbles*, London, 1890. *German Translation*, by G. Meyer, Leipzig, 1893.

529. 1890. PASCHEN, F. Zur Abhängigkeit der Oberflächenspannung an der Trennungsfläche zwischen Quecksilber und verschiedenen Electrolyten von der Polarisation. *Wied. Ann.*, 1890, Vol. 39, p. 43–66.

Lippmann's curve of surface tensions of dilute sulphuric acid with electromotive forces as abscissae have a maximum (see No. 348); the accuracy of this curve as far as the maximum is verified by the author. Beyond that his curve deviated from that of Lippmann, the cause being seen in the disturbing evolution of hydrogen. A new and sensitive electrometer is constructed which avoids this influence, and tables are obtained and curves are plotted showing the march of surface tensions with electromotive force for mercury against dilute sulphuric acid, hydrochloric acid and salt solutions.

530. 1890. PASCHEN, F. Zur Oberflächenspannung des Polarisierten Quecksilbers. *Wied. Ann.*, Vol. 40, p. 36–52.

In continuation of his previous work (see No. 529) the author finds that the curve expressing relation between surface tensions and electromotive forces beyond the maximum depends on the concentration of the solution in contact with the mercury. Furthermore, the author investigates a possible connection between the curve maximum and the beginning of electrolysis.

531. 1890. SOHNCKE, L. Die schliessliche Dicke eines auf Wasser sich ausbreitenden Oeltropfens. *Wied. Ann.*, Vol. 40, p. 345–355.

A known small quantity of olive oil or rape oil is deposited on a comparatively large water surface. It spreads out in a thin disk which soon simultaneously on all parts of the disk resolves itself into small drops. The thickness of the film immediately after its formation can be readily calculated from its diameter, its weight and specific gravity by a simple geometrical proposition. The author finds the thickness for olive oil to be about 111 micromillimeters; for rape oil about 94.

532. 1890. RÖNTGEN, W. C. Ueber die Dicke von cohärenten Oelschichten auf der Oberfläche des Wassers. *Wied. Ann.*, Vol. 41, p. 321–329.

If ether vapor falls through a funnel against the center of a circular water surface, a central cavity is formed, surrounded by a zone of elevated waves. If the surface is touched by a trace of fat, the cavity remains, but the waves are replaced by a sharply defined circle of definite diameter, contending against a concentric fatty layer. The diameter of the inner circle depends on the quantity of fat employed. If the funnel is removed the circle readily contracts.

533. 1890. CHRISTIANSEN, C. Die atmolytische Strömung der Gase. *Wied. Ann.* Vol. 41, p. 565–587.

The author defines the phenomena of Effusion, Transpiration and Diffusion of gases. Instead of the usual method of employing capillary tubes, the author uses parallel glass plates carefully ground upon each other to study the phenomena of transpiration and atmolysis of gases discovered by Graham (see No. 269). Atmolysis (separation of mixtures of gases) takes place at plate distances much smaller than the wave length of light while transpiration (involving friction) takes place at greater distances.

534. 1890. WIEDEBURG, O. Ueber die Hydrodiffusion. *Wied. Ann.* Vol. 41, p. 675–711.

A good summary of the mathematical and experimental treatment of diffusion is given. The present paper consists in a generalization of Fick's law (see No. 214) mathematically considered and examined experimentally by the same arrangement as that employed by Wroblewski (see No. 418).

535. 1891. SELBY, A. L. On the Variation of Surface Tension with Temperature. *Phil. Mag*, (5). Vol. 31, p. 430–433.

By mathematical reasoning the author concludes that Mendeleeff's rule concerning the variation of surface tension of liquids with temperature, is correct. By means of Mendeleeff's formula, the critical temperature of a liquid can be calculated by determining the surface tension at two widely different temperatures.

536. 1891. GOSSART EMILE. Remarques expérimentales sur une catégorie de phénomènes capillaires, avec application à l'analyse des liquides alcooliques et autres. *Comptes Rendus*, Vol. 113, p. 537. *Ann. Chim. Phys.* (7) Vol. 4 (1895), p. 391–423: Caléfaction et Capillarité.

In his studies of Leidenfrost's phenomenon (see No. 519), the author was led to determine by means of a sensitive pyrometer, the minimum temperatures possible for spheroidal drops to exist on heated plates. On well-polished plates of silver or gold, a spheroid of water may be maintained at even 80° C. This suggests that the spheroidal state may possibly be realized in the cold, which is confirmed by several experiments. Under this category comes the rolling of drops upon liquids of their own substance. This being due to a thin layer of vapor, sulphuric acid rolls better at 100° C. than at ordinary temperature. while ether rolls better at 0° C. than at 20° C. The drops of one liquid never roll upon another different liquid with which it is miscible, unless the latter liquid contains some of the former as an impurity. On this observation is based an even approximately quantitative method of analysis of alcoholic liquors.

537. 1891. TRAUBE, J. Ueber die Capillaritätsconstanten von Salzen bei ihrem Schmelzpunkte. *Ber. d. Deutsch. chem. Ges.* Vol. 24, p. 3074–3080. Also see *Jour. Chem. Soc. Abst.* 1892, p. 7.

For salts, a new capillary constant is established by determining the weights of drops of salts at their melting points, and dividing this value by the weight of an equal number of drops of water from the same apparatus. The tabulated results show certain regularities. Thus the new constants for potassium salts of monobasic acids lie between 112 and 157, of bibasic and polybasic acids between 163–231. The limits for the corresponding sodium-salts are 123 to 161 and 189 to 325, a bibasic acid can thus be distinguished from a monobasic acid. For example, with potassium fluoride, the results point to the formula $K_2 F_2$.

538. 1891. POCKELS, AGNES. Surface Tension. A letter communicated by Lord Rayleigh. *Nature*. Vol. 43, p. 437–439.

The surface tension of pure and impure water is measured by means of a rectangular tin trough, 70 cm. long, 5 cm. wide, 3 cm. high, filled with water to the brim. A strip of tin, about 1½ cm. wide being laid across it, divides the surface into two parts. By shifting this partition, the surface on either side can be lengthened or shortened in any proportion. The surface tension in either part of the trough was measured by the weight necessary to detach from the surface a small disk, 6 mm. in diameter. A series of systematic experiments was carried out by means of this simple apparatus (Compare No. 562).

539. 1891. BESSEY, CHARLES E. and WOODS, ALBERT F. Transpiration, or the Loss of Water from Plants. *Proc. A. A. A. S.* 1891, p. 305–308.

Among numerous references to literature on this subject, a more recent and meritorious work by ALFRED BURGERSTEIN is quoted entitled: *Materialien zu einer Monographie, betreffend die Erscheinung der Transpiration der Pflanzen.* 2 Vols. 1887 and 1889.

540. 1861. BEAL, W. J. Movements of Fluids in Plants. *Proc. A. A. A. S.* 1891, p. 309–313.

The subject is considered from two points: Ascertaining the channels which fluids take in plants, and the causes of their motion. Detailed reference is made to a recent work by MARSHALL WARD entitled: *Timber, and some of its Diseases.*

541. 1891. GARDINER, WALTER. Flow of Water in Plants. *Nature*. Vol. 44, p. 189.

The author demonstrates the existence of upward root pressure in plants, the transpiration current due to evaporation on leaves, and determines the amount of water absorbed by the root by simple measurements.

542. 1891. TRUSSEWITSCH, A. A. Surface Tension of the Halogens. *Journ. Chem. Soc. Abst.* 1891, p. 257. From *Zeitschr. Phys. Chem.* Vol. 6, p. 360.

This preliminary communication, gives the results of measurements of the capillary elevation of bromine and liquid chlorine.

543. 1891. RAMSAY, WILLIAM. The Surface Tension of Ether and Alcohol at Different Temperatures. *Reports Brit. Assoc. Adv. Sc.* 1891, p. 565–566.

The surface tension of alcohol and ether determined by means of capillary tubes, is not a linear function of temperature, the measurements being made between the ordinary and somewhat below the critical temperatures. The angle of contact for ether is 90° at the critical temperature, and becomes zero at 160° C. Below this temperature, the angle of contact has a finite small value.

544. 1891. RAMSAY, W. Surface tension of Water. *Zeitschr. phys. Chem.* Vol. 12, p. 471.

Referred to by SIEDENTOPF, 1898.

545. 1891. SENTIS, H. Method of Determining the Surface Tension of Mercury. *Phil. Mag*, (5). Vol. 32, p. 564; from *Jour. de Physique*, Vol. IX (1890), p. 384.

The surface tension of mercury is determined by allowing a rectangular plate of iron of known dimensions to float on mercury. By applying the principle of Archimedes on the one hand, and expressing the connection between capillary depression and surface tension on the other, two equations are obtained from which the surface tension independent of the edge angle may be calculated. The value found for mercury was 39.23 mg per mm.

546. 1891. MENSBRUGGHE, VAN DER. On the Condensation of Aqueous Vapor in Capillary Spaces. *Phil. Mag* (5), Vol. 31, p. 74; from *Beibl. d. Physik*, Vol. 11 (1890), and *Bull. Ac. Belg.* (3), Vol. 19 (1890), p. 101.

The author endeavors to give experimental proof of Thomson's theory (see No. 319). Examples are given of the condensation of vapors in capillary spaces, e. g. the deposition of ice flowers on the dusty part of window panes; the increased rusting of iron where it is apparently protected by cloth, dry wood, etc., the fog-producing action of dust, etc. The durability of the clothing with which Egyptian mummies are covered, depends on the filling of the capillary spaces with wax. Oil-paintings should be varnished on the back to preserve them.

547. 1891. TRAUBE, J. Capillary Constants of Organic Substances in Aqueous Solutions. *Lieb. Ann.*, Vol. 265, p. 27–55. Also see *Jour. Chem. Soc. Abst.*, 1891, p. 1408–1411.

The excess of the capillary constants of water over the corresponding constants of aqueous solutions of organic bodies, in more or less dilute solution is proportional to the concentration; in other words, the product of the concentration (expressed in molecular terms) and either of the two principal constants of capillarity (*specific cohesion* and *surface tension*, see Nos. 466 and 444) is a constant quantity in dilute solution. In the case of salts it approximates the value *one* at all concentrations (see Nos. 453 and 427). This product the author calls respectively *specific molecular cohesion* and *real molecular cohesion* (compare CARL FORCH, 1899). Elaborate tables are given for organic acids, alcohols and esters, etc., wherein these constants are recorded for various concentrations. In stronger solutions, constancy of these values is no longer maintained, and the author believes that conclusions may be drawn therefrom as to coalescence of molecules into larger groups. Some marked regularities were observed, for which see the original.

548: 1891. COLSON, ALBERT. Sur l'écoulement des liquides en tubes capillaires. *Comptes rendus*, Vol. 113, p. 740.

Owing to the indisputable influence of temperature upon the velocity of flow of liquids, especially viscous ones, through capillary tubes, the author determined in a specially devised apparatus the time of flow of 5 cc. of liquids at their boiling points. For perfectly mobile liquids, e. g. ether, aldehyde, chloroform, water, mercury, etc., the law analogous to that of Graham for gases (see No. 180) was found: The time of flow of liquids at their boiling point is proportional to the square root of their densities.

549. 1891. DRUDE, P. Ueber die Grösse der Wirkungssphäre der Molecularkräfte und die Constitution von Lamellen der Plateau'schen Glycerin-Seifen-Lösung. *Wied. Ann.* Vol. 43, p. 158–176.

The results of previous determinations of the diameter of the sphere of molecular action are here recorded. The author finds the thickness of the black film in soap bubbles to be constant, and equal to 17 micromillimeters, hence the thickness of the sphere of molecular action 8.5 micromillimeters. (Compare No. 553.)

550. 1891. KAYSER, H. Ueber Diffusion und Absorption durch Kautschuk. *Wied. Ann.* Vol. 43, p. 544–553.

In the phenomenon of diffusion of gases through Caoutchouc, the same law prevails for the quantity diffused, as in the diffusion of ammonia gas through water (see No. 551) and an equation is given expressing this law. The author confirms the observation of Wroblewski that for several gases the quantity absorbed by Caoutchouc, is in proportion to the pressure (*Henry's law*). For CO_2 and Hydrogen, the velocity of the gas passing through Caoutchouc is proportional to the temperature, which is the reverse of the diffusion of these gases through liquids. (Also see No 369).

551. 1891. MUELLER, JOHANNES. Ueber die Diffusion des Ammoniaks durch Wasser und durch Alcohol. *Wied. Ann.* Vol. 43, p. 554–567.

The Diffusion constant for a stated temperature is here defined as the quantity of Ammonia passing in one minute through a column of water or alcohol, 1 cm. long and 1 cm. square cross section at a difference of pressure of 1 cm. The ammonia is allowed to touch one end of a horizontal column of water or alcohol, the other end being in contact with air. After a stationary condition of absorption has taken place, the diffusing quantity is in proportion to the cross section, and in inverse proportion to the length of the tube. The Diffusion constants for alcohol and water at one and the same temperature seem to stand in the same relation as the respective absorption coefficients at these temperatures.

552. 1891. LOHNSTEIN, TH. Ueber den Einfluss der Capillarität auf die Gleichgewichtsverhältnisse schwimmender Körper. *Wied. Ann.* Vol. 44, p. 52–73.

Mathematical development of formulæ expressing the molecular equilibrium of drops and concave fluid surfaces; verified by measuring the volume of meniscus from its height and diameter in especially constructed cylindrical containers.

Wilhelmy's abnormal results, although wrongly interpreted by him (see No 278 and 279), and certain irregular results of Quincke lead the author to correct the usually accepted capillary theory of Gauss and Kirchhoff (see No. 115 and Kirchhoff, *Mechanik* § 5. p. 147) by taking into numerical account the surface of contact between the solid and the liquid. On the basis of this theory, a formula is derived for the equilibrium of floating bodies and verified from measurements on floating bodies of especial construction.

553. 1891. REINOLD, A. W. and RUECKER, A. W. Ueber den Radius der Wirkungssphäre der Molecularkräfte. *Wied. Ann.* Vol. 44, p. 778–783.

While agreeing in the main with Drude's numerical result regarding the thickness of the black spot in soap films, the authors object to his assertion that this thickness is equal to twice the radius of the molecular sphere of action. They hold that this sphere of action has a considerably greater radius.

554. 1892. SHENSTONE, W. A. Note on the adhesion of mercury to glass in the presence of Halogens. *Jour. Chem. Soc. Trans.* 1892 p. 452-453.

In the presence of chlorine, mercury acquires the power of adhering to glass in a remarkable degree. If chlorine is delivered into a tube filled with mercury, the tube is entirely coated with the metal. This phenomenon masks the rise and fall of mercury in pressure gauges, if chlorine is present. Bromine acts similarly, as does iodine, but to a less marked degree. These phenomena are transitory, owing to subsequent chemical combination.

555. 1892. WEINBERG, B. [Surface Tension and Temperature.] *Jour. de Physique*, 1892 p. 378; also see *Wied. Ann. Beiblätter* Vol. XVI p. 496. (1892).

The paper is referred to by T. P. Hall (see No. 573). The author finds for the surface tension of water the expression: 80.1—.177t in dynes.

556. 1892. WHITMORE, JOHN. A Method of Increasing the Range of the Capillary Electrometer. *Amer. Jour. Science*, Vol. 144, p. 64-70.

The capillary electrometer of Lippmann (see No. 348) only allows measurements of low potential differences, not higher than about 0.5 volt, owing to disturbances by polarization at higher potentials. A new capillary electrometer was constructed by the author, based on the principle that when a capillary tube is filled with alternating globules of mercury and dilute sulphuric acid, the difference of potential which can be maintained between the extremities of the series, increases proportionally with the number of globules of mercury. Each globule of mercury in contact with sulphuric acid represents a cell in the author's "series electrometer." The interposition of uniform successive cells is accompanied by an even fall in potential. Measurements of voltage of different battery cells by this method agree well with parallel measurements by means of Thomson's electric balance.

557. 1882. RAYLEIGH, LORD. On the Theory of Surface Forces. II. Compressible Fluids. *Phil. Mag.* (5) Vol. 33, p. 209-220.

An extension of the former paper, (see No. 528) to include the property of compressibility in liquids. Largely theoretical considerations concerning the constitution of the interior and the surface of fluids and their connection with vapor pressure.

558. 1892. RAYLEIGH, LORD. Experiments upon Surface Films. *Phil. Mag.* (5) Vol. 33, p. 363-373.

Miscellaneous interesting capillary phenomena are discussed, e. g. the spreading of water or olive oil on clean mercury, the former spreading slowly, the latter flash-like; camphor movements as a test of surface tension (see No. 524), the influence of heat upon a water surface sprinkled with lycopodium or sulphur, etc. If the interior of a saponine bubble is united with that of a soap bubble, the latter, having the smaller surface tension, increases, the other contracts, and becomes characteristically wrinkled. Finally the author speaks of Breath figures and their screen projection.

559. 1892. MIALL, L. C. The Surface Film of Water and its relation to the Life of Plants and Animals. *Nature*, Vol. 46, p. 7-11.

The resistance which the surface film of water offers to the passage of a solid, especially of gauze through its surface, and the tenacity with which the surface film clings to solids, especially when in the form of fine meshes (e. g. a dry muslin bag), and similar capillary phenomena are demonstrated. They explain why certain aquatic plants and animals e. g. *Salvinia aquatica;* Duckweed (*Lemna minor;*) the water spider (*Argyroneta aquatica*) etc., manage to keep dry. The account of the manner in which the water spider obtains its air supply from the surface and fastens the bubble securely under water, is extremely interesting.

560. 1892. BARKER, G. F. *Physics*. 3rd Ed. New York.

Treats of Capillarity, p. 200 & ff.

561. 1893. SUTHERLAND, W. The laws of Molecular Force. *Phil. Mag.* (5) Vol. 35, p. 211-295.

An important paper, making detailed reference to surface tension. Compare No. 503 and *ibid*, Vol 36, p. 150.

562. 1892. POCKELS, A. On the Relative Contamination of the Water Surface by Equal Quantities of Different Substances. *Nature*, Vol. 46, p. 418-419.

Lord Rayleigh's criterion of a definite degree of impurity of a water surface consists in observing the point where the motions of camphor on water cease (see No. 524). The author proposes another criterion which while indicating a smaller degree of contamination, is always fixable with great exactness, viz. that degree at which the surface tension of pure water just begins to sink, as shown by the author's method (see No. 538). A table is given, showing how much of different oils and resins is required to make a given surface enter the "anomalous" state. (see No. 572.)

563. 1892. FISCHER, E. and SCHMIDMER, E. Rise of Salt Solutions in Bibulous Paper. *Lieb. Ann.* Vol. 282, p. 156-169. Also see *Amer. Jour. Pharm.* 1893, p. 289 and *Ber.d. Deutsch. ch. Ges.* 1893 Ref. p. 35-36.

According to the authors, the difference in capillary rise of water and dissolved substance in filtering paper is due to differences in diffusion velocities. Into a glass tube 70cm. long and 2cm. wide, six snugly fitting cylinders of rolled filtering paper, each 10cm. high, were inserted, forming a continuous column. The tube was set vertically several cm. deep into the solution experimented on, until the 5th cylinder was completely wet; then the glass tube was cut into pieces at the points of contact of the cylinders, and their contents washed out and analyzed. Of a $NaCl—BaCl_2$ mixture, NaCl diffused faster, Certain molecular compounds, such as $FeSO_4$ $(NH_4)_2$ $SO_4 . 6H_2O$, are dissociated in aqueous solution. This is in harmony with their behavior towards diffusion membranes.

564. 1892. SCHMIDMER, E. *Ueber das Aufsteigen von Salzlösungen in Papier.* Dissert. Erlangen, 1892.

Covers the same subject as in No. 563. Compare Nos. 460, 259 and 578.

565. 1892. LINEBARGER, C. E. Relations between the Surface Tensions of Liquids and their Chemical Constitution. *Amer. Jour. Science.* (3) Vol. 144, p. 83-92.

Guthrie's principle (see No. 276) of determining the weights of drops falling through a column of a lighter liquid, or determining the weights of drops of a lighter liquid rising through a column of a heavier one, is herein adopted in order to arrive at a method for comparing surface tensions. Water against a number of selected organic liquids practically insoluble in water, were the fluids operated upon. Two liquids which are partly miscible, e. g. water and nitrobenzene, only yield a uniform number of drops from a given volume if either liquid is previously saturated with the other. The tabulated results show striking regularities.

566. 1892. CHABRIÉ, C. Sur le passage des substances dissoutes à travers les filtres minéraux et les tubes capillaires. *Comptes Rendus*, Vol. 115, p. 57.

The author's previous conclusion was to the effect that organic substances of high molecular volume pass less easily through capillary spaces than such of smaller volumes. The quantity of albuminous substances passing through fine capillary tubes suggests that their molecular weights should be much greater (10 or 18 times) than hitherto assumed.

567. 1892. MEYER, G. Zur Theorie des Capillar-Electrometers. *Wied. Ann.* Vol. 45, p. 508-522.

When mercury is placed successively against different liquids in a capillary electrometer (see No. 348), the direction of the meniscus movement, upon introduction of Electromotive Forces, depends on whether the meniscus is made the Kathode or the Anode, and on the chemical nature of the electrolyte. The author operated on solutions of KOH, NaOH, Na_2CO_3, K_2CO_3 and KCl, tabulating the results of his experiments. A connection is expressed between electromotive forces (charging cathodically) and manometric pressures (which are proportional to surface tensions). The descending part of the curve representing this relation (compare Nos. 373, 529 and 530) is explained by the electrolytic formation of Potassium or Sodium-amalgam which reduce the surface tension of the previously pure mercury.

568. 1892. BERTHOLD, G. Zur Geschichte des Leidenfrost'schen Phänomens, eine literar-historische Notiz. *Wied. Ann.* Vol. 47, p. 350-352.

Hermann Boerhaave [*Elementa Chemiae*, Lugd. Batav. 1732, Vol. I, p. 258] was the first to call attention very distinctly to the phenomenon of the spheroidal state exhibited for example by alcohol on red-hot iron. Musschenbroek (1762) credits Eller (1746) and Leidenfrost (see No 28) with having described it.

569. 1892. CANTOR, MATHIAS. Ueber Capillaritäts-Constanten. *Wied. Ann.* Vol. 47, p. 399-423.

The author employs two methods to determine surface tension (see No. 444). The first, that used by Sondhauss (see No. 388) exhibits in a specially devised apparatus, a well-defined and accurately measurable maximum of pulling force, from which the surface tension can be calculated. The second method consists in producing small drops of mercury in air or various fluids at the upper end of a tube having a sharp rim to eliminate the influence of a possible edge angle. The apparatus inversely allows the formation and measurement of air-bubbles against mercury. The maximum pressure consistent with the maintenance of the drop or the bubble is then determined, and the surface tension calculated from a formula herein developed. By the first method, the surface tensions of water and glycerine are determined; by the second, those of mercury against air, benzol, amyl alcohol and dilute sulphuric acid. The author finally discusses other capillary conditions, especially the connection between surface tension and temperature.

570. 1892. MINCHIN, GEORGE M. *Hydrostatics and Elementary Hydrokinetics.* Oxford, 1892.

The subject of capillarity and molecular forces has received detailed treatment in Chapter VIII. (See Book review in *Nature*, Vol. 48, (1893) p. 457-458).

571. 1893. SELBY, A. L. *Elementary Mechanics of Solids and Fluids.* Oxford, 1893.

See Book review in *Nature*, Vol 47 (1893) p. 315.

572. 1892. POCKELS, A. Relations between the Surface Tension and Relative Contamination of Water Surfaces. *Nature*, Vol. 48, p. 152-154.

The author has previously shown (see No. 562) that the tension of a water surface which receives gradually increasing quantities of oily impurity, remains unchanged until the contamination reaches a definite value (the *normal* condition), Then the surface tension abruptly decreases, first rapidly, then gradually. In this state, every mechanical increase or decrease of surface layer alters the surface tension (the *anomalous* condition). The tension of water being taken as unity, that of a saturated solution of camphor was found to be 0.72, of a strong solution of soap 0.87 (compare No. 524). An equation and diagrams are given expressing the relation between the surface tension and relative contamination.

573. 1893. HALL, T. PROCTOR. New Methods of Measuring the Surface Tension of Liquids. *Phil. Mag.* (5) Vol. 36, p. 385-413.

Method A. A film of water on a suitable rectangular glass frame suspended from one arm of a fine balance, is weighed, and the difference of weight in the same position of the frame, with broken film, is noted. This difference of weight, divided by twice the length of the film, gives the surface tension. *Method B.*, based on Wilhelmy's principle (see No. 279) applies to Ether, Alcohol, Chloroform, etc., which Method A. excludes. Tables of results are given. *Method C.* is based on the observed fact that in separating a horizontal bar from the surface of a fluid, a maximum of pull is reached shortly before separation, which maximum point can be sharply observed (compare Cantor, No. 569). By this method the surface tension of water was found to be 75.48–.140t in dynes.

574. 1893. NICHOLS, E. F. Note on the Surface Tension of Liquids. *Physical Review* 1893.

Not accessible.

575. 1893. MENSBRUGGHE, VAN DER. Sur la pression hydrostatique négative et sur la cause commune de la tension superficielle et de l'évaporation des liquides. *Comptes Rendus*, Vol. 117, p. 859-861.

Contrary to the assumptions of Laplace and Poisson respectively, liquids cannot be considered as incompressible, and the free surface cannot be in equilibrium, because surface evaporation takes place continuously. On these principles, the molecular constitution of liquids is discussed, and the author's view is shown to conform to observed facts.

576. 1893. RAMSAY, WILLIAM and SHIELDS, JOHN. The Molecular Complexity of Liquids. *Jour. Chem. Soc. Trans.* 1893. p. 1089–1109.

The capillary rise of liquids, inorganic and organic, is determined each at different temperatures that are maintained by surrounding the vessel containing the capillary tube with the vapors of different liquids of definite boiling points. In each case, an expression for the surface tension is calculated. This value, multiplied by the relative number of molecules contained in the unit of surface, yields an expression called the *molecular surface energy* of the liquid. This energy decreases linearly with increase of temperature except near the critical point where the sloping of the curve is less (compare No. 577). By measuring the temperatures downward from the critical temperature for each liquid, the resulting equation for the molecular surface energy is perfectly analogous to that expressing the well-known increase of the molecular or volume energy of gases with temperature.

The difference of the calculated molecular surface energies, divided by the difference of the corresponding temperatures, is a constant quantity. For CS_2 this value K=2.022. If the value turns out to be smaller, this indicates association of molecules, and the degree of association can be calculated. Actual measurements are recorded in detail, CS_2 being the example of a non-associating, formic acid of an associating liquid. The formula also allows calculation of critical temperatures, of which a table is given.

577. 1893. RAMSAY, WILLIAM and SHIELDS, JOHN. The Variation of Molecular Surface Energy with Temperature. *Phil. Trans.* 1893 Vol. 184 A. p. 647–678.

A more detailed exposition of the subject of No. 576, with tables, and critical review of similar work by Eötvös (see No. 478.) The *molecular surface energy* is calculated from the capillary rise for ether, methylformate, ethylacetate, carbontetrachloride, benzene, benzylchloride, all of which prove to be non-associating liquids, and for acetic acid and methyl and ethylalcohol which are shown to be associating. The limit of possible coalescence of molecules seems to be 4; methylalcohol even at -89.8°C. coalesces to not more than 4 molecules. Two sets of curves are constructed, one showing the variation of capillary rise and of surface tension with temperature, the other the variation of molecular surface energy with temperature.

578. 1893. REED, L. On the Capillary Separation of Dissolved Substances. *Proc. Roy. Soc.* 1893, p. 123. Also see *Ber. d. Deutsch. Chem. Ges.* 1894. Ref. p. 559.

Demonstrates the separating action of filtering paper upon dilute solutions of salts and acids in water. In very dilute solutions of ferric chloride 1 in 80000 or sulphuric acid 1 in 4000 the dissolved substance hardly spreads at all, while with potassium bichromate even in dilute solution, no capillary separation between salt and water can be effected. Instead of paper, compressed porous bodies, e. g. Kaolin, may be used with the same effect. (Compare No 563).

579. 1893. MENSBRUGGHE, VAN DER. Sur la cause commune de la tension superficielle et de l'évaporation des liquides. *Bull. Acad. Roy. Belg.* (3) Vol. 26, p. 37–71.

Not accessible.

580. 1893. LOHNSTEIN, Th. Bemerkungen zu der Arbeit von M. Cantor. Ueber Capillaritäts-Constanten. *Wied. Ann.* Vol. 48, p. 207-208.

Cantor's statement (see No 569) that Sondhauss's method of measuring surface tensions (see No. 370) had not hitherto been investigated theoretically and that in consequence some essential points had been overlooked, is refuted.

581. 1893. OBERBECK, A. Ueber die Eigenschaften dünner Oelschichten auf einer Wasseroberfläche. *Wied. Ann.* Vol. 48, p. 366-381.

The thickness of an oily layer on a large water surface sufficient to allay small ocean waves was determined by Sohncke's method (see No. 531) and found to be 53 micromillimeters. The thickness of oily layers were then determined on a small scale in a rectangular trough. A pure water surface was obtained by a method communicated by Lord Rayleigh (see No. 526) i. e. by blowing a current of air against the surface. By successively adding very small and known amounts of oil with powdered sulphur as an indicator. the oily layer becomes impenetrable for a moderate air current or ether vapor (compare No. 582) at a thickness of about 2 micromillimeters and above. Extremely thin layers of oil seem to dissolve in the water surface.

582. 1894. NEUMANN. *Vorlesungen über Capillarität.*

583. 1894. RAMSAY, WILLIAM, and ASTON, EMILY. The Molecular Formulæ of some Liquids as determined by their Molecular Surface Energy. *Jour. Chem. Soc. Abst.* 1894, p. 167–173.

Investigations along the lines elaborated by Ramsay and Shields (see No. 576) show that phenol, like alcohols, form complex molecules in the liquid state; bromine is likewise associated but dissociates with rising temperature into simpler molecular groupings of Br_2. Nitric acid consists largely of molecular groups of $(NO_3H)_2$. Sulphuric acid is very complex at ordinary temperature. It consists probably of not less than 32 molecules of H_2SO_4; above 132°C. a rapid diminution of molecular weight is noticeable. Phosphorus in the liquid state has a molecular weight equal to that of its gas, expressed by P_4.

584. 1894. TICKLE, T. Capillarity. *Pharm. Jour. Trans.* 1893–94, Vol. 24, p. 1055–1056.

A concise summary of the chief facts of capillarity, leading up to the results obtained by Ramsay and Shields (see No. 576.)

585. 1894. WAALS, J. D. VAN DER. Thermodynamische Theorie der Capillarität. *Zeitsch. f. Physik. Chem.* Vol. 13, p. 657–715.

Referred to by *Hulshof, Annal. der Physik* (4) Vol. IV (1901) p. 165.

586. 1894. SENTIS, H. Sur la tension superficielle des solutions salines. *Comptes Rendus.* Vol. 118, p. 1132.

In a previous article on the surface tension of salt solutions (*Jour. de Physique*, 1887) the tension of water between 0° and 30° C, was found to be 75.99 –0.152t, in absolute measurement. The formula for the tension of salt solutions contains a factor which expresses the mutual action of salt and water molecules of known percentage, exercised along the unit of length. This factor is shown to be independent of temperature between 0° and 25°C., to be proportional to the number of salt molecules up to the highest concentration, and independent of the nature of the salt.

587. 1894. PELLAT, H. Variation de la tension superficielle avec la température. *Comptes Rendus*, Vol. 118, p. 1193.

By applying the principles of thermodynamics to a given liquid mass, the author under certain assumptions demonstrates mathematically that the surface tension of a liquid in contact with its saturated vapor is a linear function of absolute temperature. This is in harmony with the conclusion arrived at experimentally by Ramsay and Shields (see No. 576).

588. 1894. QUINCKE, G. Ueber die Messung der Oberflächenspannung des Wassers und Quecksilbers in Capillarröhren. *Wied. Ann.* Vol. 52, p. 1-22.

Nine different methods that have been employed by different authors for measuring surface tension (see No. 444) are enumerated and the values for water obtained by different authors are tabulated. The author seeks to explain existing discrepancies by instituting renewed and painstaking experiments, but cannot locate the cause with exactness. Different grades of glass gave different results for pure water; the surface tension in wider tubes was greater than in narrower ones of the same material. In flat drops and bubbles it gradually diminished to the point attained at once in capillary tubes. The possible solvent power of water for glass does not give an all-sufficient explanation. The edge-angle is finite and must be taken into consideration in calculating surface tension. Determined by an optical method, it was greater in older than in freshly drawn tubes. For mercury the author again finds a surface tension from about 10 to 50% higher than was found previously by other investigators (compare STOECKLE, No. 636.)

589. 1894. QUINCKE, G. Ueber freiwillige Bildung von hohlen Blasen, Schaum und Myelinformen durch ölsaure Alkalien, und verwandte Erscheinungen, besonders des Protoplasmas. *Wied. Ann.* Vol. 53, p. 593-632.

The spontaneous formation of bubbles and foam in aqueous solutions of alkali oleates is herein considered in great detail, and the analogy of the resulting forms with the structure and motion of protoplasm is pointed out, even an analogy with the arrangement of the stars is hinted at.

590. 1894. VOLKMANN, P. Ueber die Messung der Oberflächenspannung des Wassers in Capillarröhren aus verschiedenen Gläsern. *Wied. Ann.* Vol. 53, p. 633-663, and p. 664-666.

The author's experiments with capillary tubes of different material do not bear out Quincke's statement (see No. 588) to the effect that the material of the tube influences the magnitude of the surface tension of water. The more nearly cylindrical the tube, the more the surface tension (see No. 444) approaches a definite constant value, irrespective of the material. Contrary to Quincke's views, a greater surface tension is liable to be found in narrower than in wider tubes, and in well-cleaned tubes the edge-angle is zero. In an additional note (p. 664-666) former measurements of the surface tension of water (1880 and 1882) are recalculated on the basis of improved measurements of the radius of the capillary tubes then employed.

591. 1894. KAISER, E. Das Zusammenfliessen zweier Flüssigkeitsmassen. *Wied. Ann.* Vol. 53, p. 667-683.

Two jets of water meeting from opposite directions (see No. 402) or two soap bubbles placed in contact with each other (see No. 509) frequently fail to coalesce, owing to intervening air. Upon approaching an electrified body, coalescence takes place. A theory is given for this phenomenon, and the floating of drops upon liquids of their own substance and its connection with Leidenfrost's phenomenon (compare No. 586) is discussed.

592. 1894. MEYER, G. Capillarelectrometer und Tropfelectroden. *Wied. Ann.* Vol. 53, p. 845-873.

An extension of the author's preceding study of the relation between surface tension of mercury in contact with various solutions, and Electromotive force (see No. 567).

593. 1894. LOHNSTEIN, Th. Zur Bestimmung der Capillaritäts-Constanten, Bemerkungen zu der Arbeit von Hrn. Quincke. *Wied. Ann.* Vol. 53, p. 1062-1073.

The author sides with Sieg (see No. 504) and others in pronouncing Quincke's method of measuring surface tension from flat drops and bubbles (see No. 312) as giving results too high. However by applying his own correction formulæ developed herein and in a former paper (see No. 552), Quincke's recalculated values are seen to be more in accord with the lower results obtainable by observing the height of rise in capillary tubes.

594. 1894. NATTERER, K. Capillary Rise of Sea Water in the Earth. *Chem. Centralblatt*, 1894, Vol II. p. 1014–1017.

This paper forms part of a series of "Chemical Investigations in the Eastern Mediterranean Sea, on board S. M. S. 'Pola' in the year 1893." The fact that the muddy ocean sediment contains large quantities of organic matter and ammonium salts, which are absent in the water immediately above it, leads the author to theorize regarding capillary rise of the lower water stratum into the surrounding continental masses, and consequent deposition of salt, formation of petroleum, exhalations of CO_2 or SH_2, etc.

595. 1894. SUTHERLAND, WILLIAM. The Attraction of Unlike Molecules. *Phil. Mag.* (5) Vol. 38, p. 1-19 and 188–197.

The author endeavors to find the general law of attraction between two unlike molecules, through the study of the diffusion of gases and the surface tension of mixtures of liquids. Both lead him to a law perfectly analogous to that previously announced for the attraction of like molecules (see No. 515). This law he verifies partly from data by Rodenbeck (see No. 403), and for the greater part from his own observations of the capillary rise of water and a dozen organic liquids, and mixtures prepared therefrom. He follows Elsworthy's method (see No. 505) using an inclined capillary tube; the difference being that he makes the capillary length constant by adjusting the inclination accordingly.

596. 1894. MOORE, B. On a Relation between the Surface Tension and Osmotic Pressure of Solutions. *Phil. Mag.* (5) Vol. 38, p. 279–285.

While the laws of osmotic pressure are well recognized, its cause is unknown. The author shows how it can be traced to difference in surface tension acting along the exceedingly fine capillary openings of almost molecular dimensions in the diaphragm that separates solvent from solution. The reasoning leads to a calculation of the diameter of these pores which come well within the radius of molecular action. The author finally adduces experimental evidence in support of several laws to which his theory leads.

597. 1894. RAMSAY, W. and ASTON, E. Molecular Surface Energy of Ethereal Salts and of Mixtures of non-associating Liquids. *Jour. Chem. Soc. Abst.* 1895, p. 40, from *Proc. Roy. Soc.* 1894, Vol. 56, p. 162–170, 171–182 and 182–191.

With ethereal salts (esters) the constant factor K in the equation of Ramsay and Shields (see No. 576) does not differ greatly from the mean value 2.121 for non-associating liquids, although it increases slightly with molecular weight.

The second paper contains a summary of previously established facts regarding complexity and dissociation of liquid molecules.

The change of molecular surface energy with temperature was finally examined and found to be fairly constant for mixtures of toluene and piperidine, benzene and carbon tetrachloride, chloroform and carbondisulphide. With the latter mixture, slight association was noticeable at low temperatures.

598. 1895. SUTHERLAND, W. Molecular Force and the Surface Tension of Solutions. *Phil. Mag.* (5) Vol. 40, p. 477–494.

The results of this paper present further confirmation, resp. an extension of the author's previous important papers and conclusions (see No. 595).

599. 1895. BRILLOUIN, M. Tensions superficielles et Formes crystallines. Domaine d' action Moléculaire. *Ann. Chim. Phys.* (7) Vol. 6, p. 540–574.

A general discussion of molecular action in solids and in liquids in contact with solids; surface tension being a consequence of the limitation of the sphere of molecular action. The influence of surface tension on the stability of solid edges is discussed, and the reason is given why for example, the edges in convex glass lenses break easily, even when their angle is 60° or more. In this case, as well as with agate knife edges in fine balances, two auxiliary surfaces are substituted forming a stable angle of about 120°. Finally the author discusses the influence of surface tension on the growth of crystals.

600. 1895. POINCARÉ, H. *Capillarité.* Paris, 1895.

601. 1895. RISTEEN, A. D. *Molecules, and the Molecular Theory of Matter.* Boston, 1895.

On p. 86-95, the author gives a unique review of surface tension, phenomena of films and other surface phenomena. On p. 142-145, the magnitude of molecular diameters is discussed, based on consideration of surface tension, the motion of camphor on water (see No. 562) and closely related subjects.

602. 1895. FROST-BLACKMAN, F. Experimental Researches on Vegetable Assimilation and Respiration. *Phil. Trans.* Vol. 186 B. (1895) p. 485-502 and 503-562.

The first part describes in detail a rather complicated arrangement by means of which the quantities of carbonic acid evolved from plants can be continuously and conveniently titrated with baryta water. This method is made use of in the second part to study the paths of gaseous exchange between aerial leaves and the atmosphere. The general result of these elaborate papers is that under normal condition, practically the sole pathway for CO_2 into or out of the leaf is by the stomata. Incidentally, the solubility of CO_2 in oils and waxes supposed to be insignificant, was determined and the results are tabulated. An elaborate bibliography is appended.

603. 1895. MENSBRUGGHE, VAN DER. L'évaporation des liquides et les grandes théories capillaires. *Comptes Rendus*, Vol. 121, p. 461.

Evaporation of liquids involves the necessary conclusions of diminished density in the surface, of loss in volume and absence of equilibrium. These facts are in contradiction to the postulates of the capillary theories of Laplace, Gauss, Poisson, etc. The author charges physicists with having neglected evaporation in their explanations of capillary phenomena. Furthermore he considers the contractile surface force in liquids rather a reality than a convenient assumption.

604. 1895. THADDEEFF, K. Ueber gewisse aus dem Gewichte der Tropfen geschmolzener Metalle sich ergebende Gesetzmässigkeiten. *Ber. d. Deutsch. Chem. Ges.* Vol. 28, p. 195-202.

The weights of melted drops of one and the same metal were found to be fairly constant. The author determined the weights of drops of Pb. Bi, Sn, Cd, Zn and Sb. Multiplying these weights with the atomic weights, and taking care that the dropping ensues from a surface of uniform size, the product will be the same for the first 5 metals, while the value for antimony is exceptional, viz., one-third. Similar observations have been made by Quincke and by Dupré (see Nos. 302, 304 and 288). Quincke states his observation for salts as follows: With compounds of analogous composition, the products of drop weight and molecular weight are almost an equal quantity.

605. 1895. MOND, L., RAMSAY W. and SHIELDS, JOHN. On the Occlusion of Oxygen and Hydrogen by Platinum Black. Part I: *Phil. Trans.* 186 A. (1895) p. 657–693. Part II: *ibid.* 190 A. (1897), p. 129-153.

The authors come to the following conclusions: For Pt-foil and Pt-sponge, Graham's observations (*Phil. Trans.* 1866, p. 399) are generally confirmed. Pt-*black* was shown to retain 100 volumes of Oxygen even after being dried at 100°C. A further quantity of O is absorbed upon heating as high as 360°C. Above this temperature most of the gas is given off at 400°C. *in vacuo*; but red heat only will remove it all. Platinumblack charged with oxygen will absorb about 310 vols. of Hydrogen, i. e. 110 vols. above the volume necessary to form water. Hydrogen is given off immediately from Platinum black on warming; its bulk can be extracted at 300°C. *in vacuo*. In Part II the authors state that any given sample of Pt-black occludes approximately the same volume of the different gases (H, O, CO, SO_2), pointing to a surface action of Platinum; N and CO_2 are absorbed in small quantity. For oxygen, indications are of the formation of a definite oxide. In a subsequent paper (*Phil. Trans.* 191 A. (1898) p. 105-126) the authors treat of the occlusion of O and H by Palladium.

606. 1895. DIXON, HENRY H. and JOLY, J. On the Ascent of Sap. *Phil. Trans.* 186 B. (1895) p. 563–576.

The authors accept that the suction force of the leaf is the all-sufficient cause of the elevation of sap, not by establishing differences in gas pressure, but by exerting a simple tensile stress on the liquid in the conduits. The presence of dissolved air does not interfere with the attainment of high tensions. The authors show how the leaves can draw up and evaporate water against a surrounding pressure of 2 to 3 atmospheres. The peculiar structure of the wood aids in maintaining the tensile capacity of the sap even if air is interposed (compare No. 443).

607. 1895. RANDALL, W. W. The Molecular Complexity of Liquids. *Amer. Chem. Journal*, Vol. 17, p. 461-470.

A detailed presentation of the paper by Ramsay and Shields (see No. 576) and connected papers.

608. 1895. HANNAY, J. B. On Drops. *Pharm. Jour. Trans.* 1894–95, Vol. 25, p. 1018 and 1121–22.

Tate's conclusion (see No. 281) that the size of a drop is proportional to the diameter of the delivery tube, is verified; also Traube's analogous law (see No. 489) holds good for salt solutions, such as KI, KNO_3, K_2SO_4 and $MgSO_4$. A normal drop of water measures 0.108 cc. but when dropping in benzine vapor at 87°C. its volume is 0.0449 cc. The author concludes that "the weight of a normal, i. e. an infinitely slow drop is controlled by its surface tension or contractility, while when dropping in practice, it is modified by the rate of flow, by its gravity, the viscosity of the medium in which it drops, and by its rate of fall, all of which affects the life time of the closing neck."

609. 1895. LOHNSTEIN, Th. Zur Berechnung der Capillaritätsconstanten aus Messungen an Tropfen mittlerer Grösse. *Wied. Ann.* Vol. 54, p. 713–723.

The capillary constants of Mercury in air and dilute sulphuric acid were determined by Meyer, (following A. König see Nos. 592 and 422) by measuring the radius of curvature of rather small drops of mercury at their summit, and their greatest horizontal width, and inserting these values into a formula given by Poisson (see No. 118). Since the latter formula holds good only for large drops, Meyer's results must be faulty. The author inserts Meyer's data into 2 of his own formulæ previously elaborated (see No. 593) and obtains considerably lower corrected values for the surface tension of mercury in air and against 8% sulphuric acid. (Compare J. Stöckle, No. 636).

610. 1895. VOLKMANN, P. Beiträge zur Feststellung der wahren Oberflächenspannung des reinen Wassers für Temperaturen zwischen 0° und 40° C. *Wied. Ann.* Vol. 56, p. 457–491.

By a series of most painstaking experiments the author arrives at a standard set of values for the surface tension of pure water for definite temperatures between 0° and 40°C. Special precautions are taken to insure uniformity of the temperature of the *meniscus*, since the latter (which dominates the height of rise) is very sensitive to temperature; less narrow capillaries are therefore preferable. Contrary to Quincke's statements (see No. 588) the material of the glass has no influence upon the surface tension of water, neither is the latter influenced by the width of the capillary tube. These experiments were not made with air-free water.

611. 1896. LINEBARGER, C. E. An Apparatus for the Rapid Determination of the Surface Tensions of Liquids. *Amer. Journal of Science*, Vol. 152, p. 108–122.

Simon (see No. 202) calculated surface tension by measuring the pressure necessary to force bubbles of air out of the lower end of a capillary tube. The pressure employed counteracts the capillary pressure due to surface tension and the hydrostatic pressure at the lower end of the tube. This method was modified by G. JAEGER (*Wiener Acad. Ber.* 1891, p. 245) and was adopted by the author. Two capillary tubes of different bore are employed, the narrower being movable. The liquid column in both is depressed by means of a rubber bulb. The narrower tube is raised until bubbles issue from both tubes at the same speed.

612. 1896. LINEBARGER, C. E. On the Surface Tension of Mixtures of Normal Liquids. *Amer. Jour. Science*, Vol. 152, p. 226–228.

Ramsay and Aston (*Zeitschr. f. phys. Chem.* Vol XV, (1894) p. 89) determined the molecular surface energies of liquids that do not undergo appreciable polymerization; in some instances, the molecular surface energy of the mixture was the mean of the energies of the component liquids. The author determined that the rule of alligation can be applied to the surface tension of mixtures of Benzene and Toluene; but in the majority of cases, the surface tensions of mixtures of normal liquids cannot thus be calculated. The difference of level of the lower orifices of the tubes (see No. 611) is then an element in the calculation of the surface tension of the liquid. Jäger's formula, giving only approximate results, is substituted by a formula of the author, the correctness of which is verified by using the results of Ramsay and Shields (see No. 576).

613. 1896. LINEBARGER, C. E. On the Viscosity of Mixtures of Liquids. *Amer. Jour. Science*, Vol. 152, p. 331–340.

The researches of Girard, Poiseuille, Graham, Wykander, (*Wied. Ann. Beibl.* Vol. III, 1879, p. 8) Traube, etc., are outlined (see Nos. 84, 162, 254 and 489), Elaborate tables by the author tend to confirm Wykander's results, according to which no maximum of viscosity is noticeable in mixtures of normal (non-associating) liquids. Mixtures showing a maximum have at least one associating constituent and with increase of temperature the maximum becomes less pronounced. Discusses the sometimes considerable differences between observed viscosities and those calculated by the rule of mixtures.

614. 1896. SCHOTT, O. Ueber electrisches Capillarlicht. *Wied. Ann.* Vol. 59, p. 768-772.

If the spark of an induction coil of 25cm. spark length, is passed through a capillary tube of 0.05 to 0.08 mm. inner diameter and 60 mm. length, a brilliant light is obtained of greater specific intensity than arc light. Gradually, however, the tube becomes warm, even hot, the light is dimmed, and the inner surface of the tube becomes rough. The spark passes through compressed air with difficulty; but if the capillary tube is evacuated, the spark passes easily and the light gradually becomes blue. The light is probably very rich in ultraviolet rays.

615. 1896. GENTSCH, WILHELM. Glättung der See. *Chemiker Zeitung*, 1896, No. 91, p. 911. From *Dingler's polyt. Journal*, Vol 299, p. 58-62 and 73–76.

An interesting critical discussion of theory and practice concerning the calming influence of oil upon waves. Special theoretical literature quoted are e. g. Joseph Grossmann, *Die Bekämpfung der Sturzwellen durch Oel und ihre Bedeutung für die Schiffahrt*, Wien, 1892 and M. M. Richter, *Die Lehre von der Wellenberuhigung.* Regarding the latter, see also Review in *Nature*, Vol. 49, p. 488, March 22, 1894.

616. 1896. VERSCHAFFELT, J. Capillary Rise of Liquid Carbonic dioxide near the Critical Temperature. *Zittingsversl. Kon. Akad. v. Wetensch. Amsterdam.* 1894–1896. Comm. from phys. Lab. Leyden, No. 18 (1895), and Nos. 28 and 32 (1896). Also see *Nature*, Vol. 54, p. 360.

The capillary rise of liquid CO_2 decreases in nearly linear measure with temperature as far as 30°C; between 30° and 31°C. (the critical temperature for CO_2) the height-of-rise curve must incline somewhat more towards the temperature axis. The surface energy of the liquid is then calculated and compared with the theory of Van der Waals (see No. 585.)

617. 1896. LANGLOIS, MARCELLIN. Sur une Nouvelle Théorie Capillaire. *Comptes Rendus.* Vol. 123, p. 85 and 87.

Only the title of this memoir is herein given, with the note that the second memoir published in the French Academy transactions contains "the fundamental law of the surface tension of liquids and the explanation of the very origin of this tension" from the point of view of thermochemistry. Thereto is added "the long-sought relation between the surface tension and heat of vaporisation."

618. 1897. HUEFNER, G. Ueber die Bestimmung der Diffusions-Coeffizienten einiger Gase für Wasser. *Wied. Ann.* Vol. 60, p. 134–168.

A detailed summary of previous work on the determination of diffusion coefficients of some gases into water is given. Then the author proceeds to measure diffusion coefficients for CO'_2, H, O, N, N_2O and Cl, partly by using capillary tubes, partly by operating with wider tubes closed at the lower end by a thin diaphragm of the opal-like mineral *Hydrophan*, the use of which for this purpose was first suggested by Reusch (1865). By allowing the gas to enter the lower end of the liquid column, disturbing currents due to difference in specific gravity are avoided. The results together with those of other investigators, are tabulated.

619. 1897. VOLKMANN, P. Ueber nothwendige und nicht nothwendige Verwerthung der Atomistik in der Naturwissenschaft. *Wied. Ann.* Vol. 61, p, 196–202.

Includes Meditations on the importance of Capillary theory for the molecular theory. Incidentally, Mensbrugghe's objections (see No. 603) are considered as not valid, since evaporation is a dynamic, capillarity a static phenomenon; even W. Thomson's theorem (see No. 319) treats the connection between vapor pressure and capillarity from the static point of view.

620. 1897. SIEDENTOPF, HENRY. Ueber Capillaritätsconstanten geschmolzener Metalle. *Wied. Ann.* Vol. 61, p. 235–266.

The capillary constants ("specific cohesion" see No. 466) of Hg, Cd, Sn, Pb, Bi and alloys in their molten state are calculated from measurements of the greatest diameter of drops formed by the metals, and the radius of curvature at their summits obtained by an optical method (see Nos. 470 and 478). Incidentally, part of the elaborate tables of Bashforth and Adams (see No. 481) covering the same subject, are verified. No connection is apparent between specific cohesion, or surface tension and melting points or specific gravities; the temperature coefficient, denoting decrease of surface tension with heat, is approximately the same as the coefficient of expansion. Quincke's results for Cd, Sn, Pb, Bi, determined by the method of falling drops (see No. 302) are all slightly lower; that for mercury (see No. 588) is higher than the author's. The latter doubts the absolute correctness of Quincke's law of specific cohesions (compare No. 621).

621. 1897. QUINCKE, G. Moderne Kritik der Messungen der Capillaritätsconstanten von Flüssigkeiten und die spezifische Cohäsion geschmolzener Metalle. *Wied. Ann.* Vol. 61, p. 267–280.

A polemical paper in which the author upholds all his former conclusions against the criticisms of Volkmann, Siedentopf, Lohnstein and Sieg (see Nos. 598, 620 and 504). Against Siedentopf, he upholds his law of the specific cohesion of molten metals (see No. 304) and reiterates it as follows: At the melting point of each metal the specific cohesion is 1x8.5mm^2 for Hg, Pb, Bi, Sb; 2x8.5 for Ir, Pt, Au, Ag, Sn, Al, H_2O; 3x8.5 for Pd, Rh, Cu, Ni, Co, Fe, Zn; 4x8.5 for K, 7x8.5 for Na. Finally the many different values for the surface tension of mercury obtained by different observers, are tabulated, and the cause of the discrepancy is stated to be unknown. (Compare No. 620).

622. 1897. BOYS, C. V. Capillary Ripples. *Pharm. Jour. Trans.* Vol. IV. (1897) p. 115.

In large waves, gravitation and the property of buoyancy play the principal part, but in small liquid waves (*ripples*) excited by a tuning fork (see Nos. 527 and 564) capillarity alone predominates. Capillary ripples move with such rapidity (e. g. 200 oscillations per second) that they cannot be seen with the unaided eye. It is only by means of a mechanical device (viz. looking at the waves through a series of revolving apertures following each other at the same speed i. e. 200 per second) that the waves can be seen and conveniently studied. These beautiful phenomena were rendered visible to an audience.

623. 1897. DARWIN, FRANCIS. On the Ascent of Water in Trees. *Nature*, Vol. 56, p. 307–310.

According to Prof. Strassburger (*Leitungsbahnen*, 1891; and Ueber das Saftsteigen, in *Histolog. Beiträge*, Vol. V (1893) p. 50) the modern theory regarding the rise of sap may be expressed as follows:

The sun's heat causes evaporation of the water which the mesophyll cells have imbibed; this water is replaced by imbibition from the cell sap. The concentration of the cell sap so produced maintains the osmotic force of the cell, which in turn exerts suction on the water in the tracheal cells.

624. 1897. BARENT, ST. Capillary Behavior of the Crystal-Faces of Rock salt and Sylvine towards the Mother Liquors. *Jour. Chem. Soc. Abst.* 1897, p. 9, from *Zschr. f. Kryst. und Min.* Vol. 26, (1896) p. 529–557.

The growth and form of crystals in their mother liquors are determined by the number of mass points on unit area of the faces of the crystal. A greater number of such mass points involves a lesser capillary constant. The author shows that different plates of rock salt and of sylvine (KCl) according to the crystallographic faces which they represent, under equal conditions of temperature, etc., have different capillary behavior i. e. different edge angle towards saturated aqueous solutions of their own substance. The addition of urea and other substances alters the edge angle. This explains why NaCl crystallizes from urine in octohedra instead of cubes.

625. 1897. PAYNE, GEO. F. Variation in the Size of Drops of the Same Liquid. *Merck's Report*, Vol. 6, p. 401.

The author shows the accepted statement that one fluid drachm of water yields 60 drops, to be practically unreliable. By different modes of dropping, from 18 to 600 drops could be obtained from one fluid drachm, and a variation between 33 and 120 drops is considered to be easily obtainable. The causes of these variations are discussed, and measurements of small quantities by the minim or the 10th of a cubic centimeter are recommended.

626. 1897. DORSEY, N. ERNEST. Surface Tension of Water and of Dilute Aqueous Solutions. *Phil. Mag.* (5) Vol. 44, p. 134–135 and 369-396. From *Johns Hopkins University Circulars*, June, 1897. Also see *Jour. Chem. Soc. Abst.* 1898, p. 17.

The method of ripples (see No. 622) is employed in a more sensitive form so that deviations are only ⅓%, while Lord Rayleigh's deviations were about 2%. The surface tensions of water and solutions of NaCl, Na_2CO_3, K_2CO_3, and $ZnSO_4$ were determined, the salt solutions being in concentrations of from 0.05 normal to normal volumetric. For water, the value 75.98 dynes per cm. at 0° C was obtained, while Sentis (1887) had found 76.09 by a different method. (See No. 586). The surface tensions of dilute aqueous solutions were found to be linear functions of the concentration.

The following is among the literature quoted on the surface tension of aqueous salt solutions: KLUPATHY, *Ann. d. Phys. Beibl.* Vol. XII, (1888) p. 750; CANESTRINI *ibid.* Vol. XVI (1892) p. 885, from *Riv. sc. ind.* (1891) p. 33; N. KASANSKINE, *Jour. de Phys.* (3) Vol. I (1892) p. 406; SENTIS, *ibid.* (2) Vol. VI (1887) p. 571; *ibid.* (3) Vol VI, (1897) p. 183.

627. 1897. HERZFELD, RUDOLF. Bestimmung der spezifischen Cohäsion für Kupfer, Eisen, Nickel und Cobalt. *Wied. Ann.* Vol. 62, p. 450–452.

Upon request of Quincke the author decided the following point in Quincke's law of specific cohesions (see No. 621): Does Cu belong to the second, Fe to the third group as Quincke at one time supposed? Upon examining pure drops of Cu, Fe, Ni, Co, melted in the arc light, it was found that the specific cohesion of these metals is three times that of mercury, hence all belong to the 3rd group.

628. 1897. VOLKMANN, PAUL. Bemerkungen zu meinen beiden Arbeiten über die Oberflächenspannung des reinen Wassers aus den Jahren 1894 and 1895. *Wied. Ann.* Vol. 62, p. 507-521.

The author repeated Quincke's experiment, measuring the edge angle of water against glass by total reflection of light. The method gives useful results for finite edge angles greater than 3°; Whether these 3° observed are due to an edge angle is doubtful. In concordance with former results, the edge angle of water against glass in well cleaned tubes was found to be zero.

629. 1897. HEYDWEILLER, ADOLF. Spezifische Cohäsion und Oberflächenspannung des erstarrenden Goldes. *Wied. Ann.* Vol. 62, p. 694–699 and 700-701.

A congealed gold button containing 99.5% gold and of quite regular shape was measured and the specific cohesion calculated from the data thus obtained (compare No. 304). The resulting value, however, is considerably less, almost one-third of that found by Quincke (see No. 302), whose results he holds doubtful, claiming his specimen to have been impure, judging from its apparently low specific gravity. Besides, the modern correction formulæ of Worthington and Lohnstein (see Nos. 474 and 609) established for large drops, yield too high values for Quincke's small-sized drops.

630. 1898. QUINCKE, G. Ueber die Oberflächenspannung des reinen Goldes. *Wied. Ann.* Vol. 64, p. 618–619.

The author upholds the correctness of his determination of the specific cohesion of gold, which was doubted by HEYDWEILLER (see No. 629). The specimen on which he operated was the very purest available. On the other hand, Heydweiller's specimen having contained 99.5% gold, the author says that much smaller quantities than 0.5% impurities can vitiate the height of flat drops, and thus impair the result for the specific cohesion of noble metals. The author has always found the heights of flat drops of pure gold, silver and platinum to be equal to the height of air bubbles of equal diameter in water, hence identity of specific cohesion irrespective of any correction formula (compare No. 474).

631. 1898. STARK, J. Bemerkung zur Leidenfrost'schen Erscheinung. *Wied. Ann.* Vol. 65, p. 306–310.

The oscillations and contact phenomena of water or solutions of $ZnCl_2$ and $CuSO_4$ on heated brass or silver plates (compare No. 536) are studied by making the drop and the plate part of an electric circuit supplied by a storage battery of 8 volts, and inserting a telephone. Near the boiling point, the oscillations and intermittent contacts are indicated by a rattling noise while at higher temperatures, where the intervening vapor layer is thicker, no noise is heard. The up-and-down oscillations are due to a local diminution of surface tension at the point nearest to the source of heat, which causes transient deformations of the drop; the whirling motion of the drop is due to the same cause, i. e. the difference of the tensions prevailing at the bottom and the summit of the drop which results in a continuous transportation of the lower water particles to the top where it evaporates.

632. 1898. STARK, J. Ueber Ausbreitung von Flüssigkeiten und damit zusammenhängende Erscheinungen. *Wied. Ann.* Vol. 65, p. 287-305.

The author produces numerous interesting experiments to illustrate the rule that a liquid [3] will expand on the common surface of two others [1 and 2, one of which may be air,] if the common surface tension between 1 and 2 is greater than the sum of the tensions between 3 and 1, and 3 and 2. To render the currents visible, gas soot suspended in alcohol was frequently used. The influence of temperature on surface tension is illustrated, and the centrifugal motion of the melting "stearin" in a burning candle is explained; further points treated of are the spreading of miscible liquids, and of partially miscible liquids; the action of vapors on surface tensien; the repulsion of water films by alcohol, expansion of sooted alcohol on the common surface of oil and water, etc.

633. 1898. HEYDWEILLER, ADOLF. Ueber die Bestimmung von Capillarconstanten aus Tropfenhöhen. *Wied. Ann.* Vol. 65, p. 311-319.

The capillary constant of liquid drops, i. e. "specific cohesion" of Quincke (see No. 466) can be calculated from geometrical data of the drop, viz., its greatest horizontal diameter, and its "height," i. e. the vertical distance of its summit from the plane of this diameter, and inserting the data into formulæ recently given by Lohnstein and by Siedentopf (see No. 620). The author has drawn up a table

which states the values of "specific cohesions" for definite dimensions of drops of all sizes, and verifies his table by recalculating many determinations of "specific cohesion" for mercury and water made by previous observers. With Quincke's cohesion of congealed silver drops the results are not uniform, probably owing to deformation of outline due to occluded gases. According to the behavior of Sn-Bi alloys, examined by Siedentopf, metallic admixtures (impurities) do not sufficiently account for this variation.

634. 1898. HAGENBACH, AUG. Ueber Diffusion von Gasen durch wasserhaltige Gelatine. *Wied. Ann.* Vol. 65, p. 673-706.

A 20% gelatine fluid and water absorb CO_2, N_2O, H_2S, NH_3 and O in about the same quantities. The constants of diffusion of these gases into gelatine are about 66% of the corresponding values for the same gases into water. Exner's rule, (see No. 363) according to which the diffusing gas volumes are proportional to their coefficients of absorption and inversely proportional to the square roots of their densities, holds good only approximately.

635. 1898. VOLKMANN, P. Studien über die Oberflächenspannung des Wassers in engen Capillarröhren. *Wied. Ann.* Vol. 66, p. 194-206.

Contrary to Quincke's observations (see No. 588) the surface tension of water in freshly-drawn capillary tubes gives very concordant results, independent of substance and width of the tubes. Freshly drawn tubes whether used at once or kept immersed for a long time in water, show a very slightly greater capillary constant than old, wide tubes previously well cleaned. The increase is believed to be due not to the possible existence of a small edge angle, 4½°, in the old tubes, but rather to a slight solubility of glass substance in the freshly drawn tube at the contact line of the meniscus. At any rate, the increase either falls within or just touches the limit of error of observation. (Compare No. 628.)

636. 1898. STÖCKLE, J. Ueber die Oberflächenspannung des Quecksilbers. *Wied. Ann.* Vol. 66, p. 499–522.

This important paper plainly indicates the cause of the much-discussed discrepancy in the values for the surface tension of mercury obtained by different observers. The surface tension of mercury against a vacuum is constant; its value is 44.4 mg | mm. In contact with gases, the surface tension of freshly formed surfaces is markedly higher, but upon standing it decreases, approximating or falling below the vacuum value; the decrease takes place rapidly in a hydrogen atmosphere, slowly in nitrogen. The decrease cannot be explained by the action of fatty material, but can be sufficiently explained by the condensation of gas upon the mercurial surface. The author's highest initial value for mercury against air was 49.4, which is probably still below the true value. Quincke's (1894) result, being 55.78, indicates minimum of air absorption (see No. 588).

637. 1898. MEYER, G. Die Oberflächenspannung von Quecksilber gegen Gase. *Wied. Ann.* Vol. 66, p. 523–529.

Stöckle's initial values for the surface tension of mercury in gases (see No. 636) are most probably too low, because his method did not allow immediate readings. The author obviates this source of error by employing Rayleigh's method of jets, (see No. 402) which allowed immediate readings. For mercury against hydrogen, his initial value is 56.5 mg. | mm., that of Stöckle 47.9; for mercury-air he finds 51.5, Stöckle, 48.8. Hence values obtained with pure surfaces are above 50; those below 50 are obtained with surfaces having already absorbed gas.

638. 1898. TROUTON, F. T. Measurement of Surface Tension of Liquids. *Nature*, Vol. 58, p. 191.

The method employed depends on the rate at which a column of liquid fills or empties a capillary tube when the vessel containing the bulk of the fluid is raised or lowered (compare No. 830). Experiments were also made with soap solutions, the surface tension of which varies with time (compare No. 521).

639. 1899. ARCHBALD, E. H. On the Relation of the Surface Tension and Specific Gravity of certain Aqueous Solutions to their State of Ionization. *Amer. Jour. Science*, Vol. 157, p. 313.

A general formula by Prof. McGregor, expressing either density or surface tension of NaCl or KCl solutions as a function of the same values for water, and the molecular concentration and ionic electrolytic dissociation of the solution, is herein extended to simple solutions of sulphates of sodium, potassium and copper and mixtures thereof. The equation given holds good for observed values of the surface tension and specific gravity of the simple solutions, for concentrations ranging from 0.05 to 0.5 gram-equivalents per liter. Besides, the surface tension and the specific gravity of mixtures of K_2SO_4 and Na_2SO_4 solutions can be predicted throughout nearly the same range of concentrations, likewise the specific gravity of mixtures of K_2SO_4 and $CuSO_4$, and of K_2SO_4 and KCl.

640. 1899. POCKELS, AGNES. Untersuchung von Grenzflächenspannung mit der Cohäsionswage. *Wied. Ann.* Vol. 66, p. 668-681.

In continuation of her former work (see No. 572) the author determines the interfacial tension (tension of the common surface) between water and oil or benzene, petroleum benzin, ether, etc. by two methods: (1) The *direct* method, i. e. by means of adhesion rings (compare No 570). It is applicable only if the ring is wetted by the lower liquid, which is not the case for example with alcohol and oil, because the oil displaces the wetting alcohol from the ring. (2) The *indirect* method which consists in rendering a pure water-surface "anomalous" i. e. impure by depositing on its surface a thin oil-film of known surface tension, and after expansion of the film has ceased, determining the diminished surface tension of the water by the cohesion balance. Subtracting from this value the surface tension of the pure oil, yields the tension of the common surface. Several tables are given containing the results of these painstaking researches.

641. 1899. GRADENWITZ, A. Ueber die Bestimmung von Capillarconstanten an erstarrten Tropfen. *Wied. Ann.* Vol. 67, p. 433–438.

From the measurement of the geometrical outline of congealed and liquid drops conveniently traced by parallel screen projection, Quincke's "specific cohesion" may be calculated according to tables by Heydweiller (see No. 633). Measurements were made with mercury at 15°C, water at 18° on a paraffined surface, frozen drops of water and congealed drops of silver. The deformations which often take place when drops of molten metals congeal, render this method of determining capillary constants somewhat uncertain. For this reason, Herzfeld's values (see No. 627) are considered unreliable.

642. 1899. FISCHER, KARL T. Die geringste Dicke von Flüssigkeitshäutchen. *Wied. Ann.* Vol. 68, p. 414–440.

The author tabulates the results of similar work by Plateau, Sohncke, Rayleigh, Roentgen, Oberbeck, Drude, Reinold and Rücker (see *index of authors*, below), and seeks to explain Sohncke's result that an oily layer of *uniform* thickness on water cannot be thinner than 100 micromillimeters. Operating on a surface of pure mercury on which rape-seed oil, olive oil, glycerine-water mixture, dilute sulphuric acid are severally allowed to spread, no disintegration of the film was ever noticeable during the spreading of the fluids, but always afterwards, while Sohncke noticed a different effect with water. The author obtained with the four fluids films of uniform thickness equal to less than 5 micromillimeters.

643. 1899. WALLBOTT, HEINRICH. Ein optischer Nachweis der zur Wand senkrechten Componenten der Oberflächenspannung. *Wied. Ann.* Vol. 68, p. 496–499.

When a mercury surface is in contact with a vertical glass wall, the vertical component of the surface tension of mercury manifests itself by the curvature of the mercurial edge, but the horizontal component, tending to pull the glass surface horizontally, has no visible effect, owing to the rigidity of the glass. But if a moist gelatine film is inserted between the mercury and the glass, as was done by the author for the purpose of studying phenomena of the interference of reflected light, the horizontal component of the surface tension causes the gelatine at the point of contact to be pulled outward, a deformation which first manifested itself in a disturbance of the interference phenomena. A graphic explanation of the phenomenon is given.

644. 1899. IMASS. Ueber den Randwinkel.

Dissertation, mentioned in *Chemiker Zeitung*, 1899, No. 67, p. 695.

645. 1899. LINEBARGER, CHAS. E. Surface Tensions of Solutions of Alkali Chlorides. *Jour. Chem. Soc. Abst.* 1899 p. 469, from *Jour. Amer. Chem. Soc.* 1899, p. 411-415.

Relations between the surface tension and the concentration of solutions of chlorides of Li, K and Na are established and illustrated by curves. The curve for NaCl lies about midway between those for K and Li salts, the surface tension being greater for a smaller molecular weight. If the concentrations be expressed in molecules per liter, the 3 curves become coincident. The curves show a slight convexity towards the axis of concentrations.

646. 1899. FORCH, CARL. Ueber die Oberflächenspannungen wässriger Lösungen. *Wied. Ann.* Vol. 68, p. 801–816. Also see *Jour. Chem. Soc. Abst.* 1899, p. 640.

The author follows Traube's method of determining surface tension of aqueous solutions from the weight of falling drops (see No. 489) and adopts Traube's definition of *molecular elevation or depression of surface tension*, this being the excess of the surface tension of an aqueous solution over that of pure water or vice versa, divided by the concentration expressed in gramme equivalents. For NaCl, Na_2SO_4, $NaNO_3$, for sugar and phosphoric acid, this value is nearly constant, and positive, i. e. the surface tension of the solution is greater than that of pure water. For HNO_3 and fatty acids, there is depression which increases considerably with increasing dilution, reaching a maximum at a certain concentration for each acid, then decreases, hence is not a constant quantity as was supposed by Traube. Two sets of curves are constructed both with linear concentration as abscissae, one having as ordinates the above-mentioned excess of surface tensions, the other the same divided by the molecular concentration.

647. 1899. JOHONNOTT, EDWIN S. JUN. Thickness of the Black Spot in Liquid Films. *Phil. Mag.* (5) Vol. 47, p. 501–522.

The thickness of the black film was measured by two optical methods. The author concludes that the thickness of the black film is not constant, and may vary from 6 to 40 micromillimeters. The film of a pure oleate solution may consist of two films, the thickness of the second being about one half of that of the first, the latter being about 12 micromillimeters. The addition of glycerin or KNO_3 to a pure oleate solution prevents the appearance of the second black film. An atmosphere of CO_2 thickens the black into a colored film and gradually decomposes it.

648. 1899. GRIFFITHS, ALBERT. A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids. *Phil. Mag.* (5) Vol. 47, p. 530–539.

The apparatus used is a closed rectangular vessel divided into an upper and lower compartment which are in communication by a series of tubes of known area, the tubes projecting equally above and below the dividing wall. Each compartment has an inlet and an outlet tube. For heavier liquids, the vessel is first filled with water, that in the lower compartment is then displaced by the liquid. Diffusion takes place through the tubes. The possibilities of error are discussed, and the results quite agree with theory.

649. 1899. RAYLEIGH, LORD. Investigations in Capillarity. *Phil. Mag.* (5) Vol. 48, p. 321–337.

The paper deals with the following subjects: (1) The size of drops; this is a critical examination of Tate's first law (see No. 281); (2) the liberation of gas from supersaturated solutions (see No. 340); (3) colliding jets (see No. 402); (4) the tension of contaminated water surfaces. In the latter chapter, experiments similar to those of Miss Pockels (see No. 572) are carried out and her results verified. The significance of her observations consists in the fact that the abrupt change in surface tension noticeable upon contaminated surfaces, indicates molecular distances which are thus measurable.

650. 1900. DUTOIT, P. and FRIDERICH, LOUIS. Surface tension of organic liquids. *Comptes Rendus*, Vol. 130 (1900) p. 327-330. Also see *Jour. Chem. Soc. Abst.* Vol. II (1900) p. 194.

The temperature-coefficient in Ramsay and Shields's formula for the molecular surface energy (K—2.121 for non-associating liquids; see No. 576) was determined for a number of organic liquids In abnormal liquids, the value of K varies with temperature; for normal liquids, it is not quite constant but varies within limits greater than was hitherto supposed.

651. 1900. LINEBARGER, C. E. Surface tensions of mixtures of Sulphuric acid and Water, and the Molecular Mass of Sulphuric acid. *Jour. Amer. Chem. Soc.* 1900, p. 5-11. Also see *Jour. Chem. Soc. Abst.* 1900, Vol. II, p. 273 and *Chem. Centralblatt*, 1900, Vol. 1, p. 580.

By the aid of the apparatus previously described (see No. 611) the surface tension of aqueous H_3SO_4 was determined at concentrations ranging from 2.68 to 95% and at temperatures between 0° and 70°C. It was found that the surface tension of either water or acid, especially of the latter, was raised by the addition of the other component. For the higher concentrations of H_2SO_4 the influence of temperature is very slight, due probably to a high degree of polymerization.

652. 1900. BARNES, JAMES. Conductivity, Specific Gravity and Surface Tension of aqueous solutions containing Potassium chloride and Potassium sulphate. *Jour. Chem. Soc. Abst.* 1900, Vol. II, p. 332; also see *Chem. Centralblatt*, 1900, Vol. I, p. 891 from *Trans. Nova Scot. Inst. Sci.* Vol. 10, p. 49–66.

The author found that the values for the conductivity, specific gravity and surface tension of mixed solutions of the above-named salts agree within the limits of experimental error with those calculated by means of McGregor's formula (see No. 689) from the corresponding properties of the separate solutions.

653. 1900. BAKKER G. Theory of Capillarity. *Zschr. f. Phys. Chem.* Vol. 33, (1900) p. 477–499; also see *Jour. Chem. Soc. Abst.* (1900) Vol. II, p. 466.

"The author considers the usual treatment and derivation of the laws of capillarity to be unsatisfactory, and gives a different method for their derivation."

654. 1900. PHILLIPS, C. E. S. A Surface Tension Lecture Experiment. *Nature*, Vol. 61, p. 481–582.

Water between two microscope cover glasses shows effect of surface tension. If the glasses are circular, they "set" in any position; if elliptical, or square, they "set" in one definite position, into which they return if displaced. Two circular disks, with water between, might be used, for example, to instal the moving system of a galvanometer.

655. 1900. NANSEN, F. On Hydrometers and the Surface Tension of Liquids. In *The Norwegian North Polar Expedition*, 1893-1896. *Scientific Results*, 1900, Vol. 10, p. 61.

Referred to by R. H. Weber, *Ann. d. Physik* (5) Vol. 4, (1901) p. 706-719.

656. 1900. BAKER, T. J. A Surface Tension Experiment. *Nature*, Vol. 62, p. 196–197.

This experiment refers to the formation of egg-shaped disks of water which form when a jet of water issuing from a vertical tube, strikes a horizontal disk about 7 mm. in diameter. Photographs of such waterfilms are shown for velocities varying from 4000 to 1000 cc per minute. The inner pressure is only 1 mm. of water above that outside.

This phenomenon has long been known, even for centuries. (HENRY BOURGET, *ibid.* p. 269.)

657. 1900. TROUTON, F. T. The Creeping of Liquids, and Surface Tension of Mixtures. *Nature*, Vol. 62, p. 562.

The more volatile of two constituents of a mixture of liquids creeps in advance of the other constituent. The action is stopped when evaporation is prevented. Zinc surfaces especially promote creeping. The surface tensions of mixtures of liquids are as a rule less than the values calculated from the surface tension and the proportions of their constituents. Those of salt solutions increase with the number of gram equivalents of the salt present, practically irrespective of the nature of the salt, a fact first pointed out by Quincke.

658. 1900. SMITH, S. W. J. On the Nature of Electrocapillary Phenomena. *Phil. Trans.* Vol. 193A (1900) p. 47–87.

A critical discussion of the Lippmann-Helmholtz theory of the capillary electrometer (see No. 348). Also see W. OSTWALD, *Phil. Mag.* (5) Vol. 22 (1886) p. 70; Vol. 27, (1889) p. 365-366; Vol. 29 (1890) p. 479-480; Vol. 30 (1890) p. 506-507; and J. BROWN, *Phil. Mag.* (5) Vol. 27 (1889) p. 384-392; Vol. 29, p. 376; Vol. 30, p. 170-171.

659. 1900. VINCENT, GEORGES. Sur l'Epaisseur des Couches de Passage. *Ann. Chim. Phys.* (7) Vol. 19, p. 421–516.

On plates of glass, thin layers of silver were deposited, varying in thickness from 0 to 170 micromillimeters, and the electric conductivity for different thicknesses was determined. The results point to the existence of a double layer (*couches de passage*) of less conductivity, having a total thickness of 50 micromillimeters, the outer is in contact with air, the inner with the glass, between them being a homogeneous intermediary layer if the total thickness exceeds 50. The author claims that Quincke, in his silver film experiment (see No. 307) did not obtain the distance of molecular activity; what he obtained was the thickness of the above-stated double layer.

660. 1900. DÖRGE, O. Eine Studie über Seifenblasen. *Ann. d. Physik* (4) Vol. I, p. 1-16.

The first part of the paper consists in a theoretical application of Carnot's principle of the transformation of energy, to the case of soap bubbles receiving electrical energy which causes a change of inner pressure. In the second part, these variations are measured by the movement of a liquid index in a capillary tube, at its one end connected with the interior of the bubble, at its other end with a fixed volume. Upon charging the bubble electrically, the index moves in the direction demanded by the theory. Some quantitative measurements are made.

661. 1900. QUINCKE, G. Ueber die Dicke der Uebergangsschichten (couches de passage), und die Wirkungsweite der Molecularkräfte. *Ann. d. Physik*, Vol. II, p. 414-420.

Rejoinder to Vincent (see No. 659). Among other opinions he points out that films of alkali oleates do not present a homogeneous composition owing to hydrolysis, resulting in 3 layers each of unknown thickness, hence the thickness of such films is not a comparable quantity and does not permit calculation of the radius of the sphere of molecular action.

662. 1900. STEVENS, JAMES S. A Method for Measuring Surface Tension. *Amer. Jour. Science*, Vol. 160, p. 245-246.

In measuring surface tensions by the method of disk detachment (compare No. 588), two difficulties exist, viz. the tension by the balance cannot be added in *continuous* increments, and it is difficult to apply the pull exactly at the "center of inertia" of the body to be torn from the liquid surface. These difficulties the author obviates by counteracting the pull by means of a magnetic coil which receives a current capable of being gradually reduced by the insertion of a continuous resistance system.

663. 1900. MÜLFARTH, P. Ueber Absorption von Gasen an Glaspulver. *Ann. der Physik* (4) Vol. 3, p. 328-352.

The paper is introduced by a most detailed collection of literature on the absorption of gases by glass. With powdered glass, the author arrived at the following results: Notable quantities of CO_2 are absorbed even by perfectly dry powdered glass, absorption increasing with decreasing temperature or with increasing pressure, in the latter case approximately obeying Henry's law, and being completed after 1 to 2 hours. Moisture retards absorption, but it is completed in 1 or 2 days, and the total absorbed quantities are about equal with dry or moist powder. The quantities absorbed are not even approximately as high as those recorded by Bunsen for glass threads (see No. 469). The gases C_2H_2, N_2O, CO_2, SO_2, NH_3 are absorbed in increasing quantities in the order named. Bunsen's "capillary absorption" does not seem to hold good for powdered glass.

664. 1900. GRUNMACH, LEO. Experimentelle Bestimmung der Oberflächenspannung von Flüssigkeiten und geschmolzenen Metallen durch Messung der Wellenlänge der auf ihnen erzeugten Capillarwellen. *Ann. d. Physik*, Vol. 3, p. 660-671.

The surface tension of a liquid mass may be calculated from data obtained by the method of capillary waves or ripples (FARADAY, 1831; SCOTT RUSSELL, 1834; L. MATTHIESSEN, *Pogg. Ann.* 1868, Vol. 134, p. 107, *Wied. Ann.* 1887, Vol. 32, p. 626, and *ibid.* 1889, Vol. 38, p. 118; SIR W. THOMSON, *Phil. Mag.* 1871, Vol. 42, p. 368). The ripples are generated by means of tuning forks (Matthiessen); the specific gravity, the number of vibrations per second, and the wave-lengths determine the surface tension. Values thus obtained for water, alcohol, sugar solutions, etc. show close agreement with those obtained from measuring height of rise of the same liquids in capillary tubes. The same method was employed in determining surface tension of molten metals. The value for tin is considerably less than that obtained by Quincke and by Siedentopf (see No. 620).

665. 1900. SUTHERLAND, W. The Molecular Constitution of Water. *Phil. Mag.* (5) Vol. 50, p. 460–489.

The author investigates in detail the constitution of water on the basis of its thermal behavior; the compressibility of water and the dissociation of ice into water by pressure; the surface tension and the constitution of the surface film; the viscosity, latent heat of fusion, specific heat and latent heat of evaporation, etc. As a result of this exceedingly interesting study, the author names the vapor of water *hydrol*, H_2O; ice is *trihydrol* $(H_2O)_3$ and liquid water at ordinary temperatures is a mixture of *trihydrol* and *dihydrol* $(H_2O)_2$ in varying proportions. Probably at its critical temperature, liquid water is practically *pure dihydrol.* The polymerisation of hydrol is only a special case of a general tendency of oxygen compounds, both organic and metallic, to polymerize.

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